ILLUMINATING ENGINEERING

NOVEMBER 1955

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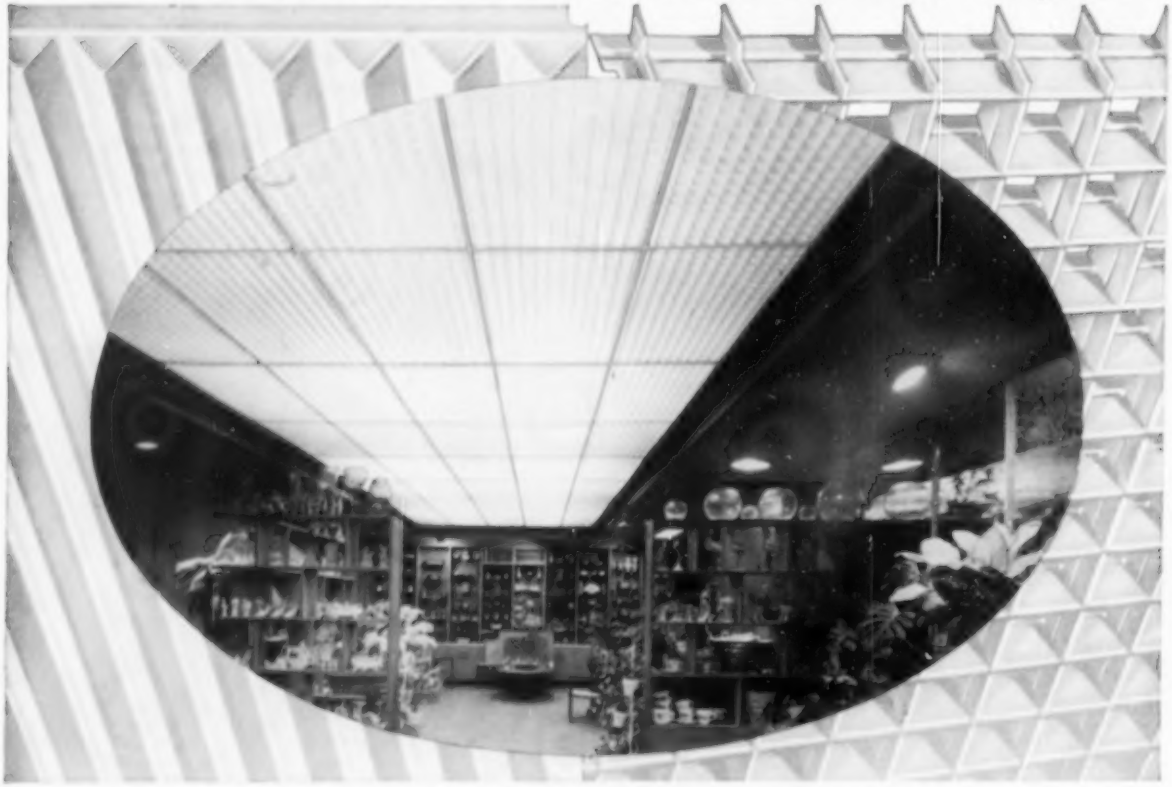

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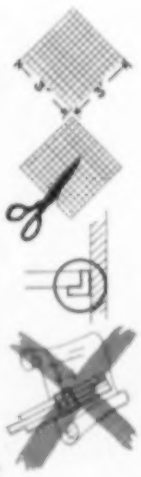

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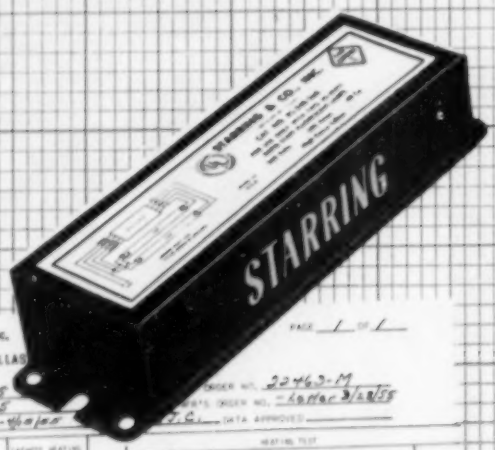

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THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

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Contents

521 George C. Schroeder, Jr. — Hospital Design with a Future

524 Harold H. Fisher — Westminster Presbyterian Church

526 H. M. White — Louvered Lighting Makes Night Baseball Legal

528 Gordon L. Dovey — Quality Lighting As Production Booster

530 James Bale — Quality and Economical Aspects of Parking Area Lighting

539 I.E.S. Lighting Data Sheet — Series XX
Floodlighting a Tower (24-28)

541 Walter S. Greenwood — Mural Lighting in a Church Dome

543 E. E. Vezey — A Brightness Meter for Use in Model Studies of Buildings

545 I.E.S. Lighting Data Sheet — Series XX
Lighting an X-Ray Fluoroscope Room (18-11)

547 John O. Kraehenbuehl — Graphical Determination of Illumination by Solid Angle Projection Methods

553 I.E.S. Home Lighting Data Sheet
A Luminous Ceiling in a Traditional Kitchen Dinette (22-49)

555 W. H. Johnson — Signboard Lighting Economics

562 I.E.S. Lighting Data Sheet — Series XX
Lighting a Building Identification Sign (23-9)

563 Charles N. Clark — Designing Show Window General Lighting with PAR and R Lamps

Also: Recessed Lighting — To Keep the Records Straight, 538; Lighting Designed for Human Comfort, 544; Cove Lighting in a Masonic Lodge, 552; Lighting a Living Room for Christmas, 561

6A TELECAST — Lighting News of Current Interest
Lighting Calendar, 31A; About People, 40A; New Members, 45A.

37A-38A I.E.S. Publications

54A Index to Advertisers

Sustaining Members — For latest listing see September ILLUMINATING ENGINEERING

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1st Prize milj

Hospital Design with a Future

By GEORGE C. SCHROEDER, JR.
New Orleans Section, Southern Region

SATISFACTORY engineering is its own reward to the designer. When the plan carries out its share of civic purpose and humanitarian motives, the reward is rich indeed. A project eminently satisfactory in this respect was the design for the Crippled Children's Hospital of New Orleans.

The objective was to construct a building which would have all the facilities, equipment, and functional properties of a specialized hospital, and yet be warm and inviting to the little children treated there. The architects and the consulting engineers coordinated their plans from the first, to this end. Lighting design was a major factor in producing such an environment. Surface color and finish were very important, and even the selection of furniture called for special attention. Each area of the hospital had its own problems, and required individual treatment.

At the main entrance the lighting starts from the driveway and continues without break into the main lobby and waiting room. This pattern of recessed troffers acts as a directional arrow to guide visitors and patients inside, as well as serving functionally to illuminate the area.

In the waiting room, 2-foot by 4-foot recessed louvered bottom units are used, with three 40-watt fluorescent lamps. All fluorescent lamps used in the hospital are T12, rapid start, standard cool white. One side of the waiting room consists of sliding glass walls which open to the patio. Planting in the patio is highlighted by 150-watt PAR-38 floodlamps in bullet-shaped aluminum hoods.

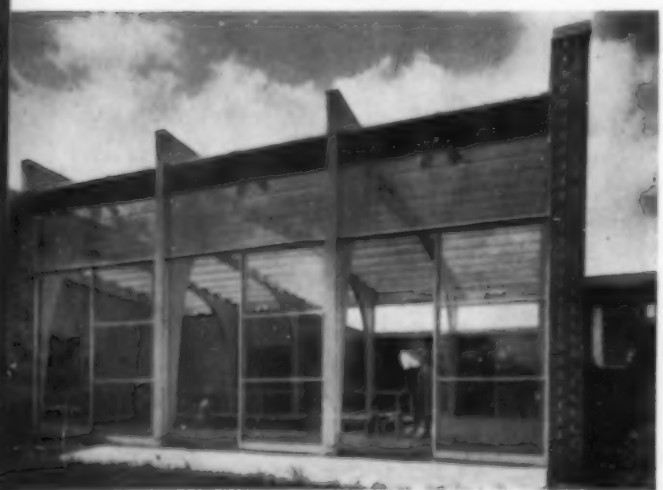
Similar bullet-shaped units have been used for stairway lighting, to avoid the usual "institutional" atmosphere.

Corridors have much higher levels than are usually found in these areas, for the safety of the handicapped children. Those used by the patients

AUTHOR: Consulting Engineer, Schroeder and Associates, New Orleans, La.; formerly Design Engineer with Louis N. Goodman and Associates, New Orleans, Consulting Engineers on this installation. Architect was Ricciuti Associates, New Orleans.

Crippled Children's Hospital, New Orleans.

Main entrance — lighting starts from driveway and continues without break into main lobby and waiting room.



Heated therapy pool with lighting from clusters of swivel units, translucent plastic roof and glass walls.

have surface mounted, louvered bottom fixtures in continuous rows, using single 40-watt lamps. In the nursing area, two by two-foot recessed units are used, louvered, with three 20-watt fluorescent lamps. The switching arrangement here allows the illumination level to be reduced to one footcandle for night lighting.

Physical Therapy

Weakened limbs and muscles are scientifically exercised in the special Therapy Gymnasium and Pool. Lighting for this department is from all white, porcelain enamelled steel reflectors employing 300-watt silver-bowl lamps. The upward component in these reflectors keeps the ceiling from being totally dark, reducing brightness contrast. The heated pool, where many children will learn to walk for the first time, has translucent plastic roof and sliding glass walls. Lighting is from clusters of swivel units using PAR38 floodlamps mounted on the wall between the laminated wood arches. The effect is very pleasing as well as functional.

Inpatient Area

Center of activity in the inpatient area is the central nurses' station. Here is located the heart of the nurse call, doctors' paging and music systems, as well as fire alarm and civil defense warning systems. Some 40 footcandles are provided in this area, from four recessed 200-watt incandescent units, each having full Alzak aluminum reflector and photolight lens bottom. Two of these units are connected to the emergency lighting system.

For psychological reasons nursing units are known as "cottages," of which there are eight in the hospital. Each cottage has seven beds, housing the children in small, family-like groups. For each pair of cottages, there is a day room equipped with television, games, writing materials, and toys. Here too, the switching arrangement is flexible for the nurses' choice of three different levels, according to the activity. Lighting is from two by four recessed, louvered bottom 3/40-watt fluorescent units.

Bed Lighting

Of all the lighting systems used in the hospital, probably that in the cottages has created the most discussion. At each bed location, the architect had included in his design, a patient unit consisting of a book shelf, chalk, tack and writing boards, and space for clothes and brace storage. The lighting problem was to coordinate the placing of a bed light, convenience outlet, and nurse call facilities into this ingenious unit.

While working out the details for the placing of these items, we conceived the idea of mounting lights on top of the unit to provide general lighting in the room. Working in close coordination with the architect, the final design of the patient unit was materialized. Note details from the cross section drawing.

A cove is formed in the unit by a partial recess in the top rear section. In this recess we have placed two 40-watt fluorescent strips; behind the lamps a polished Alzak aluminum reflector. Over the lamps is a clear piece of Plexiglas held in a wood frame which forms part of the unit. Fluorescent lamps are used rather than incandescent, because of the lower surface temperature. The Alzak reflector serves to project the larger part of the light output toward the center of the room. The Plexiglas cover is at an angle, to provide ease of cleaning and to prevent paper or other articles from being placed on top of the fixture. Illumination resulting from this system is a well-diffused general lighting which averages 10 footcandles.

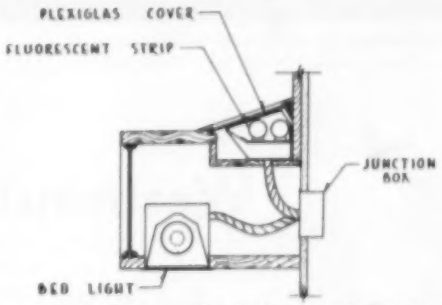
The additional bed light incorporated in the unit is an incandescent source recessed in the underside of the bookshelf, directly over the bed. This may be controlled by the child, from a silent type switch. With the bed in position, each child has available 50 footcandles for reading or chalk-drawing. The bed light too has a full Alzak aluminum reflector. Its lens is of impact-resistant glass, which is of special construction so that if by chance it should be broken, it will disintegrate into small harmless particles. All screws used to hold the lighting fixtures and other electrical equipment in place are of the tamper-proof type, making the installation safe from the inquisitive hands of small children.

Wall and ceiling finishes in the cottages have been carefully planned for brightness control and pleasing appearance. The wall above the cove on one side of the cottage is finished in natural redwood paneling, with a brightness of 5.9 footlamberts. The opposite wall is of buff brick, 25 footlamberts. Ceiling brightness decreases gradually from 50 footlamberts directly above the bed coves, to 10 footlamberts at the center of the room.

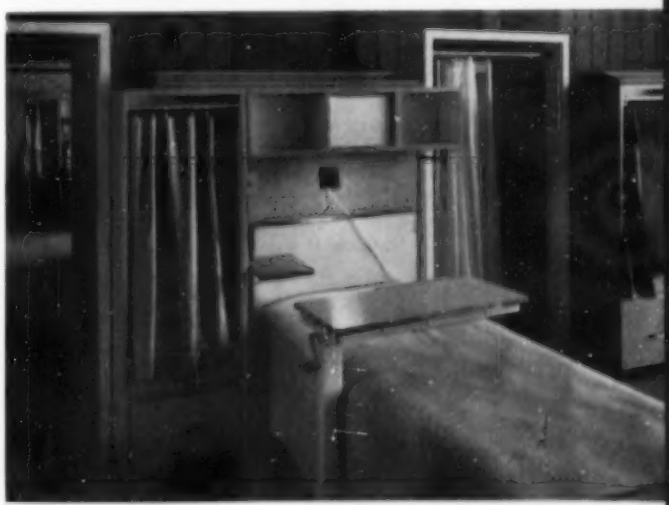
The overall effect, as seen through the sliding glass walls, is one of cozy cheerfulness where the children have a comfortable visual environment for a variety of activities in an atmosphere conducive to recovery.

The entire hospital is an asset to the city of New Orleans. It is a marked step forward in the care of crippled children — and its lighting contributes definitely to that end.

"Cottage"-type housing — with seven children in each unit. General lighting is from fluorescent strip recessed into the patient bed units.



Bed unit provides both general fluorescent lighting from top and an incandescent source recessed in the underside of the bookshelf for reading or drawing light.



Book-shelf, chalk, tack and writing boards and space for general clothes and brace storage, table, bed light and general lighting are provided by patient unit.

Floodlighted tower and gold window.

Nave viewed from pulpit.

Westminster Presbyterian Church

A SIMPLE but very effective cove lighting installation in the Chapel of this Detroit church was the starting point for the installation shown here. The Chapel, built in 1948 and preceding by several years the main church unit seating 1000, was designed with a coved ceiling lighted by cold cathode tubing. So successful was this system that all concerned with the final building wished a similar method for the church. The church ceiling, however, was not to be a simple cove. And the final installation includes far more than a cove — reflecting, I believe, the owners' appreciation of the role of lighting in the beautification of a church.

Exterior Lighting

To the passer-by, the effects achieved with both lighting and design, suggest the modern beauty to be found within. The tower, stone to the top of the spire, is successfully floodlighted at night, and the sixteen beautifully carved panels bearing the symbols of the four Gospels — Matthew, Mark, Luke and John — around the top level, and the twelve apostles, three on each side, are clearly visible. Around the top of the spire we designed a six-foot diameter gold crown. Atop the crown is a gold sphere with a Latin cross mounted thereon, to symbolize the spread of Christianity throughout the world.

The large sculptured gold window in the front entrance is also floodlighted from the exterior. An almost ethereal effect is obtained by additional back-lighting from the pastor's study, which is located behind the window and above the vestibule. In the entrance design, figures of Jesus and the people of all nations are thrown into bold relief. The entrance itself is a very beautiful "welcome," even more impressive at night, with its warm effective illumination.

Interior

As will be noticed from the photograph, the cove lighting system in the nave is considerably expanded in design from the simple cove of the origi-

AUTHOR: Harold H. Fisher and Associates, Architects, Detroit, Mich.

Church as seen by congregation.

Photographs courtesy of Detroit Edison Company

Sanctuary with stained-glass reredos.

By HAROLD H. FISHER
Michigan Section, Great Lakes Region

2nd Prize

nal chapel. The ceiling is a series of curves or "ocean waves" with a three-foot shelf at the front edge of each ceiling section, containing eight rows of cold cathode lamps. Since the lighting system was an integral part of the building plans, it was necessary for us to decide upon the design of a ceiling which would serve as a good light reflector, before we could design the steel for supporting the roof. The importance accorded to the lighting design in all plans for this building is one of its more unusual features, and is a major factor in its final effectiveness.

At reading level, illumination measures 24 foot-candles in the central part of the nave, and 20 foot-candles at the side aisles. The main lighting coves are designed for maximum light spread to prevent high brightness in the cove proper, when loking back from the chancel.

The chancel area itself is lighted with downlights and the altar wall by cold cathode tubing installed on the edge of the ceiling and wall. Several incandescent floodlights also play directly upon the gold-leafed reredos. Lighting for the altar wall, for the chancel and for the nave, is on separate motor-operated dimmers.

Reredos

In addition to the supplementary floodlighting, the very beautiful stained-glass reredos is further lighted, for focus of attention, by means of a large plaster cove extending from floor to roof at each side of which is installed cold cathode tubing. Additional floodlights on the floor of the cove light the life-sized representation of the Lord's Supper during the Communion Service. Still further incandescent floodlights are installed at the top of the cove, to feature the 13-foot figure of Jesus. Several spotlights are so located that on occasion the altar, and/or the gold reredos may be further highlighted.

Considerable latitude of lighting variations on the face of the altar wall, as well as from behind, is afforded by the dimmer controls. Lighting effects may be accompanied by lighting on the face alone, to pick up the gold, or additional lighting from behind to feature the colorful stained-glass and to

bring up the figures into bold relief.

All lighting in the church is three-way. The complete controls are located in the panel at the organ console, and in a special alcove in the foyer. Above the ceiling of the church (in the attic space) we installed a walk way on the center line of the nave to provide easy accessibility to the lighting transformers. This walk-way is well lighted, and the transformers are accessible for service.

Not shown in the pictures are classrooms, social hall, kitchen and lounge, all of which feature carefully planned lighting.

Artist, architect and engineer have been teamed for the most effective results, in this installation. The stained-glass windows, for example, are contemporary in design and original in this particular treatment. Architectural features further enhance their beauty, and with the application of the engineered design of the lighting, it is difficult to imagine the impact these jewel-like windows make upon the people who worship here. This is so, even for the people who pass by in the night.

Louvered Lighting Makes Night Baseball Legal

3rd Prize

By H. M. WHITE
Maryland Section
East Central Region

TWO VARIETIES of blazing light were featured in the opening discussions on the proposed new home for the Major League Baltimore Orioles baseball team — the Baltimore Memorial Stadium.

One was the blazing light of publicity. Court injunction proceedings, widely reported in the press, were brought by residents near the proposed site, who wanted the Major League team, but not in their back yards.

The other blazing light existed only in the minds of these neighborhood residents and was the cause for their protest. This was the light which they feared would be projected through their windows by the floodlighting system for night games.

I had been called at the proceedings as an expert witness for the City and the Orioles, and had mentioned the possibility of louvering the floodlights—a suggestion which the press headlined as "Ingenious Venetian Blinds Proposed for Stadium Floodlights."

After the proceedings an Ordinance was enacted, ruling: "That the respondents be and they are hereby permanently enjoined and strictly prohibited from projecting blinding lights into the windows and the homes of the complainants and nearby residences, but they are not enjoined from actual lighting up the area as such, in a necessary concomitant of playing night baseball."

It was now my ball. Investigation showed that the real annoyance to the neighborhood was the viewing of the lamp filaments — the beam of the projectors being directed into the playing area. I also found that glare annoyance was confined in a band, between horizontal with the floodlights to approximately 15 degrees below horizontal in the vertical plane and extending throughout approxi-

AUTHOR: Lighting Service Department, Baltimore Gas and Electric Co., Baltimore, Md.

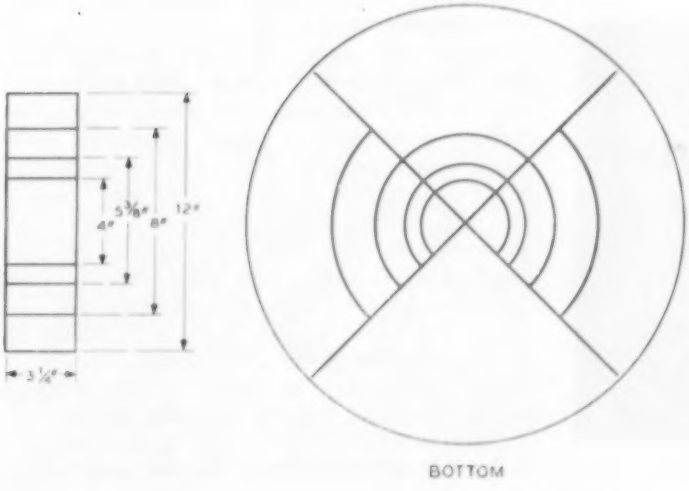
Light from Memorial Stadium is "... *permanently enjoined and strictly prohibited from entering nearby residences ...*" by louvers on the floodlights.

mately 160 degrees in the horizontal plane. I felt that if the filament could be shielded in this zone, the Ordinance could be met. The final louver design for each of the 20-inch 1500-watt floodlights had fins on only the side quadrants and partially on the top quadrant; none on the lower quadrant. When the center of the beam is directed 25 to 30 degrees below horizontal to cover the playing area, the design is such that the filament will be shielded throughout the critical zone. Some spill is allowed above horizontal to supply light for pop flies.

With the results of this study and planned design the Court was convinced that the lighting could comply with the Ordinance, and it sanctioned the erection of the new stadium.

The stadium is oval in shape, 560 feet long and 390 feet wide. It is lighted by 1302 1500-watt floodlights burned at 10 per cent over-voltage to deliver 200 footcandles on the infield and 150 footcandles on the outfield. The lights are mounted on eight towers, 162 feet above the ground.

The louver system has proved effective as filament shield and brightness control, and night baseball has proved as popular in Baltimore as elsewhere.



Louver design—fins on side quadrants, and partially on top quadrant; none on the lower quadrant. Some spill is allowed above horizontal, for pop flies.

4th Prize

Quality Lighting As Production Booster

By GORDON L. DOVEY
Southern California Section
South Pacific Coast Region

PRODUCTION increase, in one instance, of more than 28 per cent after re-lighting was reported to us by the Frawley Corporation, Culver City, Calif., makers of Paper-Mate pens — a dramatic illustration of the dollars-and-cents value of quality lighting in industrial production areas. And the improvement in employee morale is of the sort which is immeasurable.

Since such owner service is the engineer's main objective in a lighting recommendation, it follows that the practical success of this installation was especially gratifying to me.

The assembly area, which was the first to be relighted, is 80 by 87 feet with a high arched ceiling painted white and light green walls. The "before" photo shows a typical section, for hand and machine assembly of the small parts required in the manufacture of the ball point pens. Inspection and packaging for shipment is also completed in this area. The work requires speed in handling small, even minute, parts. Women of all ages are employed for this work on production line tables. Prior to re-lighting, there was a spotty 18 to 40 footcandles on the tables, supplied by a haphazard arrangement of 2-lamp 4-foot industrial fixtures suspended 7 to 7½ feet above the floor.

Assembly area — before.

AUTHOR: Southern California Edison Co., Santa Monica, Calif.

After — assembly area, far left, and machine shop, left.

To supply approximately 150 footcandles of good quality, evenly-distributed light on the production line tables, 77 4-lamp 8-foot slotted louvered industrial luminaires were installed—slotted for 10 per cent upward component to the high ceiling, and louvered for additional brightness control. The luminaires are mounted in continuous rows on 8-foot centers, suspended 8½ feet above the floor, 2 feet from the end wall and 3½ feet from the side walls. Initial illumination levels were 200 footcandles.

To enable the electricians to install the new lighting system without interrupting production, and to assist in keeping the long rows straight and level, one-inch pipe was first suspended in continuous rows from the ceiling. This work was done above the existing fixtures without disturbing them. Then the luminaires were fastened to the pipe and the old fixtures removed, a job which was completed overnight, between "quitting-time" on Thursday and Friday morning.

Another reason for the one-inch pipe was that the electric service and main switch are located, as they so often are, in one corner of the plant, and if the company liked the lighting, wiring codes would allow us to use the pipe for a wire-way to feed the second half of the rows, which I *hoped* they would continue across the machine shop area.

My hope was realized: the one-inch pipe suspension system was put to use in relighting the rest of the plant. I was called back the very next week for my recommendations on re-lighting the machine shop area. Here the continuous rows were of the same 8-foot luminaires, and some 6-foot units to bring the rows close to the end wall. The machines are set at a 45-degree angle under the rows. Two-lamp lead-lag 430 ma ballasts and single-pin standard warm white T-12 lamps were installed throughout the plant.

The dark green lockers in the background of the assembly area have been removed, and the work tables have been painted ivory. Brightness ratios are now well within recommended limits.

Employee morale, that intangible asset, was boosted even higher when the Frawley Corporation rounded off the relighting program by having the same quantity and quality illumination installed in the coffee and lunch room areas.

Lunch room re-lighted.

Quality and Economical Aspects Of Parking Area Lighting

By JAMES BALE

Ask Mr. or Mrs. John Q. Public, just returned from a harried motor trip into the business section of the average town or city across the country today, what is one of their town's most pressing needs, and the positive and perhaps a little profane answer will often be, "More parking space." With more than 46,460,000 passenger cars alone on our streets and highways, one car for every 2.8 persons according to the 1953 motor vehicle registration figures, parking lots have long since become a permanent and very vital part of our society. Commercially, parking today is big business, and nearly every new industrial plant, shopping area, commercial dwelling, or recreation area must devote a substantial portion of its available ground area to this purpose.

Whenever a parking area is to be used at night, and a majority are to some extent at least, it is socially and economically important that it be well lighted. Light in the parking area performs two services. The first and most vital of these is to provide increased safety from physical injury, accident, or thievery for the occupants of the vehicles utilizing the parking area, the vehicles themselves, and the personal property they contain. The second service is advertising. This service is especially important to the commercial lot or to the commercial area relying primarily on vehicular trade for its source of revenue.

Before an adequate lighting installation can be provided for any designated parking area, it is necessary to first determine the lighting needs of the area. To simplify this procedure, parking areas may be divided into the following general classifications which are summarized in Table I.

Courtesy Lots — Courtesy lots are those parking areas provided by an individual commercial or industrial establishment, or a group of establishments, as a service to its patrons or employees. They are provided to promote good will between the owner and the user, and no fee is required for this use. Courtesy lots can be further divided into two sub-groups: Semi-private courtesy lots, and customer courtesy lots. The semi-private lot, as the name implies, is utilized by a somewhat restricted group of authorized personnel and the lighting is required for safety purposes only. Apartment house parking areas, restricted business lots, and industrial parking areas are examples of the semi-private lot. The customer courtesy lot, however, is lighted not only for safety purposes but also to attract patrons by offering a parking area that is bright, attractive, and easy to move about in. For this purpose the level of illumination should necessarily be higher than that required for safety purposes only. The modern shopping center parking area is an excellent example of a customer courtesy lot, and is rapidly increasing in importance.

TABLE I — Classification of Outdoor Parking Areas and Summary of Lighting Requirements.

Classification	Fee Required for Parking Privilege	Lighting Required Primarily for Safety Purposes	Lighting Required for Safety and Advertising
I. Courtesy Lots	No		
A. Customer Courtesy Lots			X
B. Semi-Private Courtesy Lots		X	
II. Commercial Lots	Yes		
A. Privately Operated			X
B. Municipally Operated		X	
C. Part Time Lots		X	
III. Public Lots	No	X	

Commercial Lots — A commercial lot is a parking area operated as a commercial venture either for profit or as a self-supporting or partially supporting service by an individual, a company, or a municipality, and a fee is charged for the parking privilege. The lot may or may not be attended. On a privately operated commercial lot increased illumination for advertising purposes above that required for safety alone is generally desirable. On the municipally operated lot the quantity of illumination required is more often determined by the safety requirements only. This is also frequently the case where a lighting installation is designed for an unattended parking area whether privately or municipally controlled. Here, however, the minimum level required for safety purposes should be considerably greater than the "minimum safety level" for the attended parking area. A third type

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of commercial lot is a part-time lot, one operated only for the duration of some particular event. An example of this is a parking lot adjacent to a baseball stadium. The successful operation of this type of parking area is generally assured by its favorable geographical location, and thus lighting is required for safety purposes only.

Public Lots—Public lots are those parking areas provided free of charge for use by the general public. They serve no particular commercial interest and again may or may not be attended. The need for illumination is for safety purposes, being somewhat higher if the lot is unattended than if it is attended, or if it is located in a remote or poorly policed area.

With parking areas separated into the above classifications, it is now possible to assign recommended levels of illumination that will more accurately provide for the use to which a specific parking area is to be put. A table of recommended footcandle values is shown in Table II.

TABLE II — Recommended Average Horizontal Footcandles.

Classification	Industrial, Remote or Unprotected Area	Business, Residential or Well Policed Area
1. Courtesy Lots		
A. Customer Courtesy Lots		0.8 - 2.0
B. Semi-Private Lots		
Employee Parking	0.6 - 1.0	
Residential Parking		0.3
2. Commercial Lots		
A. Privately Operated		
Attended	0.6 - 1.0	0.6 - 2.0
Unattended	0.8 - 1.0	0.8 - 1.2
B. Municipally Operated		
Attended	0.6 - 1.0	0.6 - 1.0
Unattended	0.8 - 1.0	0.8 - 1.0
C. Part-Time Lots	0.6 - 1.0	0.6 - 1.0
3. Public Lots		
A. Attended	0.6 - 1.0	0.6 - 1.0
B. Unattended	0.8 - 1.0	0.8 - 1.0

The lower illumination value under any particular sub-classification is the minimum level of illumination recommended for any parking area under that classification and it provides for safety purposes only. The higher footcandle value shown is a preferred level based on current good practice, and when required by the classification this level considers advertising requirements as well.

As with any lighting installation, providing only the proper quantity of illumination alone does not guarantee a satisfactory lighting installation. Equally important, but more difficult to evaluate, is the quality of the illumination. The lamp and luminaire combination selected to perform the lighting task should provide a uniform level of illumination that is free from harsh shadows and objectionable glare. Since a parking area is in effect an extended street, a maximum uniformity variation of 4 to 1 between the average and minimum point anywhere in the parking area is recommended. On the commercial or customer courtesy type parking lot where an important function of the lighting installation is to attract customer attention, the entrances to the parking area should be given special consideration. A level of illumination at these important points equal to at least twice the average level over the general parking area will permit the entrances to be readily detected and will make them serve as focal points to entice potential customers into the parking or shopping area.

Many different systems of lighting are available today for lighting the parking area. Street lighting and floodlighting equipment employing both the incandescent and the mercury sources have been used extensively for this purpose. The relatively new fluorescent street light, pump island area luminaires, and reflector lamps have also served in this capacity. There are many popular misconceptions concerning the economy of various lamp-luminaire combinations for parking area lighting. Since the economics of any particular system will vary considerably with such factors as area size, number of burning hours, power rates, and type of maintenance, there is no one system which will be more economical for all parking area lighting. To determine the most economical lighting system for any given type parking installation a cost analysis similar to that shown in Table III should be made taking into consideration all of the factors mentioned above. This procedure coupled with a thorough analysis of the quality of the various types of lighting systems is the only method by which the customer can be sure of getting the most for his lighting dollar.

Because of a constantly increasing demand for shopping center parking area lighting, the cost analysis shown in Table III has been prepared to compare economically nine of the more common systems of lighting used for this purpose.

This analysis is based on the typical medium sized shopping center parking area shown in Fig. 1.

This area has a width of 355 feet and a length of 870 feet comprising a total of 309,000 square feet. The parking islands run perpendicular to the long axis of the parking area and are 60 feet apart. The design level of illumination for the area was 1.5 footcandles average maintained in service, although in a few instances spacing requirements dictated the use of a slightly higher or lower level as indicated in line 11 of the analyses.

The nine luminaire-lamp combinations considered were: The mercury street lighting luminaire with the 400-watt, 700-watt and 1000-watt fluorescent mercury lamps; the fluorescent street light

TABLE III — Cost of Lighting Analysis for Typical Shopping Center Parking Area. 309 Square Feet. Designed to Provide Approximately 1.5 Footcandles Maintained in Service. Distribution System 120/240 Volt Multiple.

	LIGHTING SYSTEM NUMBER	1	2	3	4	5	6	7	8	9
DESCRIPTION OF LIGHTING SYSTEMS	1. Type of lamp (Sl., merc., preheat fluor., slimline, etc.)	Fluores. Merc.	Fluores. Merc.	Fluores. Merc.	Fluores-cent	Fluores. Merc.	Fluores. Merc.	Fila.	Fila.	Fila.
	2. Lamp description	J-H1	B-H18	B-H15	F100T12 CW/RS	J-H1	B-H18	PS-52	PS-52	R-40
	3. Type of luminaire	Street light Type IV	Street light Type IV	Street light Type IV	Street light Type IV	Flood light Type 6	Flood light Type 6	Flood light Type 6	Flood light Type 4&5	Refl. Lamp Holder
	4. Number of lamps per luminaire	One	One	One	Four	One	One	One	One	One
BASIC DATA	5. Rated initial lamp lumens per luminaire	19,000	33,000	50,000	21,400	19,000	33,000	21,600	21,600	4,600
	Mean or Beam Lumens	15,000	25,500	37,700	17,550	10,900	19,582	13,420	11,870	4,600
	6. Lamp life	6,000	6,000	6,000	7,500	6,000	6,000	1,000	1,000	2,000
	7. Watts per luminaire (including auxiliary) Plus 10% line loss	492	828	1,163	539	492	828	1,100	1,100	550
	8. Coefficient of utilization	.59	.59	.59	.37	.85	.80	.65	.75	.85
	9. Maintenance factor	.90	.90	.90	.90	.75	.75	.75	.75	.75
	10. Number of luminaires	60	45	30	87	66	43	54	70	160
	11. Average footcandles maintained	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
	12. Energy rate ($ per KWH)	$ .025	.025	.025	.025	.025	.025	.025	.025	.025
	13. Estimated burning hours per year	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
INITIAL COST	14. Net luminaire cost (each)	$ 48.16	96.80	96.80	217.80	36.04	36.04	36.04	49.97	4.12
	15. Net additional accessory cost per luminaire[1]	$180.27	234.50	284.45	99.73	189.19	293.71	176.03	196.72	132.17
	16. Estimated wiring & installation cost per luminaire	$ 62.71	68.90	85.85	45.61	59.20	67.43	52.92	25.33	36.45
	17. Net initial lamp cost each (list less 40%)	$ 13.44	29.70	35.70	2.37	13.44	29.70	1.68	1.68	2.16
	18. Net initial lamp cost per luminaire (4 × 17)	$ 13.44	29.70	35.70	9.48	13.44	29.70	1.68	1.68	2.16
	19. Total initial cost per luminaire (14 + 15 + 16 + 18)	$304.58	429.90	502.78	372.62	297.87	426.88	266.67	255.70	174.90
	20. TOTAL INITIAL COST (10 × 19)	$18,275	19,346	15,083	32,418	19,659	18,356	14,400	17,899	27,984
ANNUAL FIXED CHGS.	21. Initial cost per luminaire less lamps (14 + 15 + 16)	$291.14	400.20	467.08	363.14	284.43	397.18	264.99	254.02	172.74
	22. Total initial cost less lamps (10 × 21)	$17,468	18,009	14,012	31,593	18,772	17,079	14,309	17,781	27,638
	23. ANNUAL FIXED CHARGES (15%[2] of 22)	$ 2,620	2,701	2,102	4,739	2,816	2,562	2,146	2,667	4,146
ANNUAL OPERATING COSTS	24. Annual no. lamp replacements (4 × 10 × 13 ÷ 6)	15	11	8	70	17	11	81	105	120
	25. Annual cost of replacement lamps (17 × 24)	$201.60	326.70	285.60	165.90	228.48	326.70	136.08	176.40	259.20
	26. Annual cost of replacement parts (starters, etc.)[3]	$174.68	180.09	140.12	315.93	187.73	170.79	143.09	177.81	276.38
	27. Total annual maintenance material cost (25 + 26)	$376.28	506.79	425.72	481.83	416.20	497.49	279.17	354.21	535.58
	28. Estimated labor cost to replace one lamp	$ 1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	29. Total labor cost to replace lamps (24 × 28)	$ 15.00	11.00	8.00	70.00	17.00	11.00	81.00	105.00	120.00
	30. Estimated cleaning cost per luminaire	$ 2.00	2.00	2.00	3.00	2.00	2.00	2.00	2.00	——
	31. Number of cleanings per year	Two	Two	Two	Two	Two	Two	Two	Two	——
	32. Annual cleaning cost (10 × 30 × 31)	$ 240	180	120	522	264	172	216	280	——
	33. Total annual maintenance labor cost (29 + 32)	$ 255	191	128	592	281	183	297	385	120
	34. Total Annual Maintenance Cost (27 + 33)	$ 631	698	554	1,074	697	680	576	739	656
	35. Annual Energy Cost (7 × 10 × 12 × 13 ÷ 1000)	$ 1,107	1,397	1,309	1,758	1,218	1,335	2,228	2,888	2,300
	36. TOTAL ANNUAL OPERATING COST (34 + 35)	$ 1,738	2,095	1,862	2,832	1,915	2,015	2,804	3,627	2,956
TOTAL AND REL. COSTS	37. TOTAL ANNUAL COST (23 + 36)	$ 4,358	4,796	3,964	7,571	4,731	4,577	4,950	6,294	8,102
	38. Relative Annual Cost	$ 1.10	1.21	1.00	1.91	1.19	1.15	1.25	1.59	2.04
	39. Annual Cost per Footcandle (37 ÷ 11)	$ 2,352	2,197	2,642	5,854	3,154	2,861	3,300	4,196	5,401
	40. Relative Annual Cost per Footcandle	$ 1.27	1.21	1.00	2.20	1.19	1.08	1.25	1.59	2.04

[1] Pole, ballast, cable.

[2] One per cent of Line 22.

[3] Usually 15 per cent assuming 10-year amortization with 5 per cent allowance for taxes, insurance and interest.

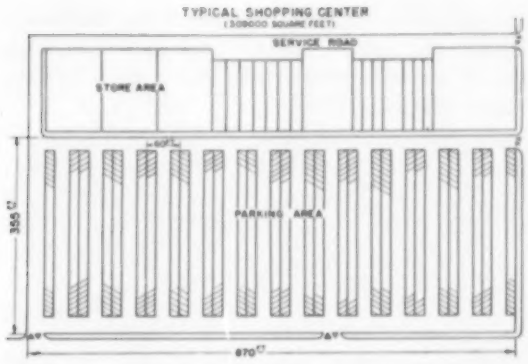


Figure 1. Outline drawing of the typical shopping center parking area (309,000 square feet) used as a basis for cost comparison of various lamp-luminaire combinations.

utilizing four 100-watt T12 rapid start fluorescent lamps and tilted at an angle of 30 degrees above horizontal; a relatively low mounted Type 6 floodlight with the 400-watt and 700-watt fluorescent mercury lamps and the 1000-watt PS-52 clear general service incandescent lamp; a combination of high mounted Type 4 and 5 floodlights utilizing the 1000-watt PS-52 incandescent lamp; and a simple lampholder employing the 500-watt R-40 reflector flood lamp. The street lighting luminaires were mounted on conventional steel standards at a height of approximately 30 feet with the 400-watt and 700-watt mercury luminaires on 8-foot bracket arms and the 1000-watt luminaires on 15-foot bracket arms. The Type 6 floodlights were also mounted at a height of approximately 30 feet for use with the 400-watt mercury lamp and the 1000-watt incandescent lamp, but a mounting height of 40 feet was selected for the 700-watt mercury lamp to improve uniformity and to reduce the build-up at the base of the pole. The combination of Type 4 and Type 5 floodlights was mounted at a height of 60 feet, while the reflector lamps were placed at a height of approximately 25 feet.

In each layout the luminaires were placed to obtain as good a utilization and as high a quality of lighting installation as the luminaire would provide. To obtain good uniformity over the parking area and to avoid a spotty appearance resulting from large build-ups around the poles, a maximum of two street lights or four floodlights or reflector lamps was permitted per pole with the exception of installation number 8. In that instance, in keeping with the purpose of the high mounting height, a maximum of nine luminaires on a single pole was used. When the spacing permitted, the outside row of luminaires was located on the perimeter of the parking area and directed inward to reduce spill light and to avoid objectionable glare in the areas adjacent to the parking lot.

The Annual Fixed Charges for each installation based on a ten-year amortization of the initial cost with a five per cent allowance for taxes, insurance, and interest is shown in line 23 of the analysis. Even with the considerable price differential that exists between the street lighting and the floodlighting luminaires the annual fixed charges for the mercury street lighting systems and the mercury floodlighting systems show little variation between them. Line 23 column 3 shows the street lighting luminaire with the 1000-watt mercury lamp to be the lowest in initial cost, since considerably fewer luminaires are required. The 1000-watt fluorescent mercury lamp is not practical for use in floodlighting equipment as the size of the light source would make control virtually impossible in that type of luminaire and its use would result in an inefficient application of the source and an unreasonably high build-up of illumination in the area of the pole. With the 700-watt source in the floodlight, the additional cost of the higher poles required for its satisfactory use brings the cost of that system to a par with the cost of the street lighting systems. It is interesting to note that the cost of the incandescent floodlighting system, column 7, in spite of the absence of ballast costs and the large decrease in lamp and luminaire costs over the street lighting system still falls within the range of the mercury installation because of the lower efficiency of the incandescent source and higher cable prices. The low utilization obtainable with the fluorescent luminaire, line 8, column 4, and the "Cadillac" price of the equipment places that installation highest in the Annual Fixed Charges line. Second in magnitude is the reflector lamp installation. The large number of standards required to maintain the quality requirements established and high cable costs more than offset the extremely low lamp and lampholder investment. High pole costs and a lower coefficient of utilization also place the multi-unit high mounted floodlight system high up on the initial cost list contrary to popular belief.

The Total Annual Maintenance Costs shown in line 34 of the cost analysis indicate little advantage for either the mercury street lighting systems or the mercury floodlighting systems one over the other. As the mercury sources progress to higher wattages, the higher lamp costs must be more than offset by an equivalent reduction in cleaning and relamping expenses, fewer luminaires being required, before they can be economically employed. This occurs with the 700-watt size in the floodlighting systems and with the 1000-watt in the street

lighting systems. The incandescent floodlighting system, column 7, shows some advantage over the majority of the mercury systems but frequent lamp replacements and a large number of units to service makes this advantage very small. The fluorescent installation, the high mounted floodlight installation, and the reflector lamp installation all reflect the economic handicap of an installation requiring a large number of luminaires.

The Annual Energy Cost, line 35, inherently favors the mercury installations. Again, with an increase in lamp wattage the energy cost is seen to increase until the reduction in the number of units is sufficient to overcome the additional wattage consumption of the larger sized lamp. The overall energy costs of the 700-watt and 1000-watt mercury lamps are in all cases higher than for the 400-watt source but with the use of the 1000-watt lamp the trend is started downward again. For the incandescent installations the energy costs progress upwards in order of the number of lamps required with the reflector lamps having the highest energy cost of any of the installations.

Combining the fixed charges, maintenance costs, and energy costs and reducing them to a cost per footcandle basis, the overall economic picture is obtained as shown in the summary bar diagram, Fig. 2, based on *Relative Annual Cost per Footcandle.*

The summary diagram readily indicates that for economically lighting a medium or large size parking area to approximately 1.5 footcandles of the best quality lighting obtainable with any of the given lamp-luminaire combinations, the choice of equipment would be between one of the mercury street lighting installations or one of the low mounted floodlighting installations. For this size and quality of lighting installation the fluorescent system, the reflector lamp, or the multi-unit, high mounted floodlighting system should merit no more consideration.

The mercury systems are particularly adaptable to large area installations, relatively long burning hours, and high energy costs. If any one of these factors is substantially decreased the incandescent sources might easily become generally more advantageous, or conversely, if any one is increased substantially, the economic advantages of the mercury sources would become more pronounced.

Small area size, lower footcandle levels, short burning hours and reduced uniformity requirements might, in some instances, make reflector lamps economical for parking area lighting. The fluorescent street light with its broad distribution is capable of producing excellent quality lighting, and at relatively low levels of illumination its area coverage is good. Its initial cost is high, however, and for shopping center parking area lighting, where levels between 1.0 and 2.0 footcandles are generally employed, the low candlepower of the luminaire and its high cost make it economically impractical. Its chief attribute is its novelty as a rather new and still relatively uncommon type of luminaire for outdoor lighting. High candlepower, long range floodlighting equipment such as used in installation number 8 is not satisfactorily adaptable to quality parking area lighting at the footcandle levels commonly used today. The analysis shows that this type of lighting in a fairly large parking area is not the most economical type of lighting by far if good uniformity is to be preserved. Even though good uniformity at levels of 1 to 2 footcandles can be obtained through this

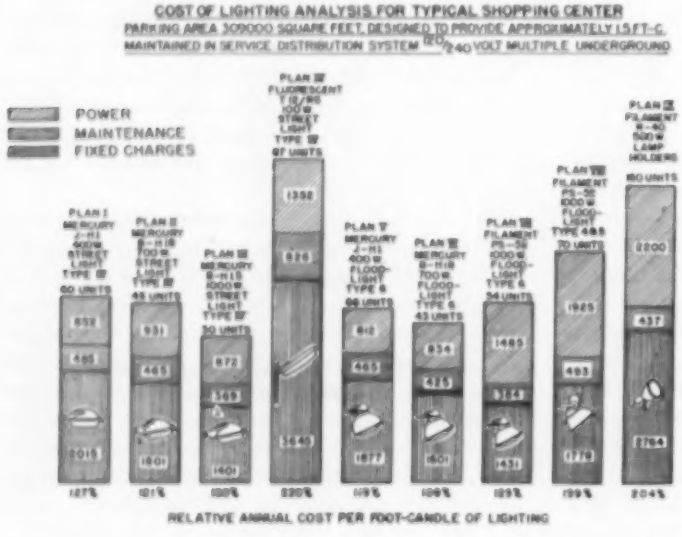


Figure 2. Summary bar diagram of Table III showing relative annual cost per footcandle.

medium over an area that is large enough to permit long throws and multiple floodlight locations, the high aiming angles required to obtain large area coverage will produce long harsh shadows and the high candlepower is an irritating source of objectionable glare. In the smaller lot requiring only one or two poles to achieve complete coverage of the area, the type of lighting illustrated in Fig. 3-A is apt to result, making it easy for the thief or vandal to go about his work unseen in the protective blackness of the shadow areas.

Figure 3-A (top). Long throws and too few floodlight locations produce deep shadows that provide adequate protection for the thief or vandal.
Figure 3-B (bottom). Uniform quality lighting adds safety and comfort to the parking area.

Such an installation is in sharp contrast to the uniform quality lighting illustrated in Fig. 3-B.

Some of the quality aspects of the economically acceptable lighting systems can be compared in an analysis of Table IV.

For a given wattage size in the mercury lamps the maximum candlepower with the floodlighting units in every instance is somewhat higher than with the street lighting luminaires. Since the total candlepower distribution with the floodlight is also considerably narrower than with the street light, this must lead to the conclusion that not only is the floodlight a more objectionable glare source, but with the narower distribution it is on the average more difficult to obtain good uniformity through this medium. This is borne out in both the "ratio of minimum to average" line and the "ratio of minimum to maximum" line of Table IV.

A final factor of quality to consider in selecting a lamp-lumipaire combination for parking area lighting is appearance. This is particularly important in the "customer courtesy" type lot. Millions of dollars are spent on the modern shopping center to provide the customer with attractive, convenient shopping facilities. The lighting in the parking area should add to the general appearance of the store area and become a part of an overall attractiveness rather than stand apart as a purely functional auxiliary. The graceful upswept mast arms of the street lighting standard and the streamlined silhouette of the modern street lighting luminaire serve well in this capacity.

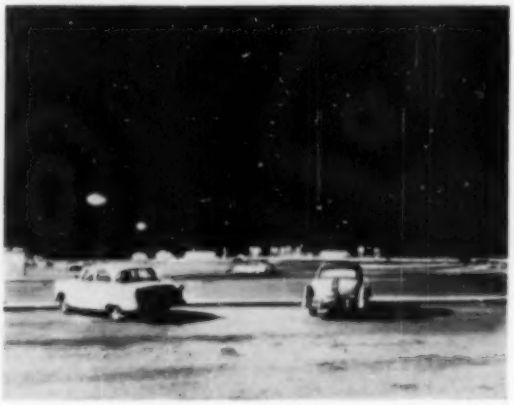
TABLE IV — Candlepower and Uniformity Characteristics of Typical Lamp Luminaire Combinations for Parking Area Lighting.

Plan	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7	Plan 8	Plan 9
Unit Description	Mercury J-H1 400-watt Street-light Type IV	Mercury B-H12 700-watt Street-light Type IV	Mercury B-H15 1000-watt Street-light Type IV	Fluorescent T12/RS 100-watt Street-light Type IV	Mercury J-H1 400-watt Flood-light Type 6	Mercury B-H18 700-watt Flood-light Type 6	Filament PS-52 1000-watt Flood-light Type 6	Filament PS-52 1000-watt Flood-light Type 4 & 5	Filament R-40 500-watt Lamp-Holder
Maximum Candlepower	4435	8167	9843	3130	6727	9086	25142	44600	3800
Average Footcandles	1.3	1.5	1.5	1.3	1.5	1.6	1.5	1.5	1.5
Minimum Footcandles	0.44	0.39	0.39	0.37	0.36	0.42	0.30	0.38	0.30
Ratio of Min. to Avg.	1:3.0	1:3.8	1:3.8	1:3.5	1:4.2	1:3.8	1:5.0	1:4.0	1:5.0
Maximum Footcandles	2.54	4.60	5.75	1.75	8.80	5.10	9.50	1.72	1.95
Ratio of Min. to Max.	1:5.8	1:11.8	1:14.7	1:4.7	1:24.4	1:12.1	1:31.7	1:4.5	1:6.5

A

B

C



D

E

F

Figure 4-A. The graceful lines of the street lighting luminaire add to the beauty of a modern shopping center.

Figure 4-B. Day view of a typical parking area floodlighting installation. Luminaires mounted at 40 feet. Poles spaced 200 feet apart.

Figure 4-C. Night view of Fig. 4-B. Note the bright "hot spots" at the pole base.

Figure 4-D. Harsh shadows resulting from unidirectional floodlighting.

Figure 4-E. Day view of a 700-watt mercury street lighting installation.

Figure 4-F. Adequate level of illumination and good quality lighting provide safety and comfort in this parking area.

The classification of a parking area according to its purpose and the selection of the required level of illumination to adequately aid in performing that task is the first step in designing a satisfactory parking area lighting installation. The second step is to select the most economical and capable lamp-luminaire combination to provide the desired level and quality of illumination. Conventional low mounted, wide beam floodlighting equipment utilizing either the mercury or incandescent source, or the mercury street lighting luminaire, are best suited to perform the lighting job economically and efficiently. In those installations where price is the prime consideration and slightly less than the maximum quality standards are acceptable, the low mounted floodlight is the obvious choice. Where good coverage, high quality and appearance are all important factors, the mercury street light will best answer the question "What luminaire should I use in the parking area?"

DISCUSSION

R. H. Goodman*: Mr. Bale is to be complimented for his thorough approach to this subject. The matter of selecting the proper lighting equipment for parking area lighting has been a controversial subject for some time, and this paper is helpful in evaluating the various available systems.

Our Society has been "quality-conscious" for some time in interior lighting, and Mr. Bale is to be congratulated on making the same approach in outdoor lighting. I believe he has also made a very logical approach in his classification of outdoor parking areas. His table of recommended average horizontal footcandles is certainly more realistic than any previous published data.

However, I would like to ask several questions, particularly in reference to his cost of lighting analysis. It seems that significant savings could be made by using 1500-watt incandescent lamps in the type 4 and 5 floodlights analyzed in his System #8. An immediate savings would be in the number of luminaires required. Also an analysis of the 400-watt E-H1 or J-H1 mercury vapor lamps in the same system would be interesting. It would seem that they would effect a considerable savings in operating cost.

With regard to the maintenance factor shown in Line 9 in Table III, I am curious to know why a maintenance factor of 90 per cent is used for the street lighting luminaires and 75 per cent for floodlights. As originally set up by NEMA, the 75 per cent MF for floodlights included lamp depreciation as well as collection of dirt, etc. on the floodlight. Does the street lighting MF take into account all of these factors, or does it only cover dirt accumulation?

On page 535, Mr. Bale states that with the narrower distribution with the floodlights, it is, on the average, more difficult to obtain good uniformity through this medium. Table IV does not seem to bear this out. For Plans 1, 2 and 3, using street lighting equipment, the ratios of minimum to maximum are respectively 1-3, 1-3.8 and 1-3.8. This ratio for Plan 8 using floodlights is 1-4. This slight increase does not seem significant. The ratios of minimum to maximum for street lights are 1-5.8, 1-11.8 and 1-14.7. This ratio for Plan 8 using floodlights is only 1-4.5.

*Crouse-Hinds Co., Syracuse, N. Y.

F. D. Wyatt*: The author has presented a paper on a very important subject on which I wish to make several comments.

The 400-watt mercury unit listed in Type J-H1, color corrected. Any comparison of costs should include the type E-H1 lamp, which has both lower cost and higher light output. The E-H1 lamp, probably, is in greater use for parking areas than any other mercury lamp. We have never found any serious objection to the color of E-H1 lamp and can see no reason for burdening the installation with the higher cost of the J-H1 lamp.

The light levels shown in this paper for parking areas vary from 1.3 to 1.6 average footcandles. This level is probably adequate for relatively inactive parking storage. However, for shopping centers of the type shown on Fig. 4-B, 4-C, 4-E and 4-F, the light level seems inadequate.

The trend, today, is towards maintained illumination of around 5.0 footcandles for such areas where pedestrians are moving, carrying packages, and towing children, and moving in and out of the automobile traffic lanes. Any economical analysis of parking lighting for such areas should consider the drawing power for sales of a brightly lighted parking lot.

Attention should be called to the fact that the Street and Highway Lighting Committee and the Store Lighting Committee are both making studies of the proper amount of light for parking areas at shopping centers. It is unfortunate that this paper should present a recommendation of 1.3 to 1.6 footcandles when the final Committee recommendation for lighting shopping center parking areas undoubtedly will be a considerably higher figure.

J. Bale**: The author wishes to thank Messrs. Goodman and Wyatt for their comments on this paper.

In answer to Mr. Goodman's specific questions: There are several disadvantages to using a 1500-watt lamp in the floodlights employed in plan 8. The 1500-watt lamp is used primarily for sportslighting where footcandle levels from 10 to 100 footcandles or more are desired. When this lamp is used in a type 4 or 5 floodlight to obtain a level of 1-2 footcandles for parking area use the units must be spread further apart and good uniformity is more difficult to obtain. Also the use of this lamp would increase considerably the peak candlepower of either type of luminaire adding to the potential uncomfortable glare conditions that can readily result from the use of only a few poles and long throws. As indicated in Table III the maximum candlepower of these units is already far in excess of any of the other systems, even with the 1000-watt lamp.

In regard to the use of the E-H1 mercury lamp in the above type of unit, it must be remembered that the cost analysis presented in the paper is for a shopping center parking area. Straight mercury vapor lighting is fine and has been used to a considerable extent on the industrial type of parking area, but for the shopping center where a majority of the patrons are of the fairer sex the effect of straight mercury vapor lighting on the complexion and on colors is frequently found to be objectionable. The use of the fluorescent mercury lamp in this type of installation would defeat its purpose. Such an installation is generally installed on the theory that by using fewer poles and longer throws a considerable saving will result. When the fluorescent mercury lamp is used in a floodlight a very wide beam spread and a correspondingly low peak candlepower is obtained due to the size of the source. As a result

*Electrical Engineer, Chicago Park District, Chicago, Ill.
**Author.

the footcandle levels in the immediate pole area would build up considerably and a very spotty appearance would result over the total area.

With regard to the maintenance factors shown in line 9 of Table III the difference lies in different methods of calculation used for streetlighting and floodlighting. In streetlighting, when average maintained footcandles are desired, it is general practice to use the mean lumens of the lamp employed and a maintenance factor for dirt depreciation only. In floodlighting calculation procedure the maintenance factor incorporates both the loss in lumen output due to the ageing of the lamp and the loss in output due to dirt accumulation on the surfaces of the floodlight.

Mr. Goodman's last question has been partially answered in the first paragraph. On page 534, last sentence, it is stated that with this type of equipment good uniformity can be obtained at levels of from 1 to 2 footcandles. However, to achieve this result the size of the lamp that can be used is limited as explained previously. The author's principal objection to this type of installation, however, aside from the high cost if good uniformity is obtained, is the glare and objectionable shadows that can result. This type of installation can be engineered to produce fairly satisfactory results. But often very poor lighting conditions result through mounting too many units to a single pole and using too great a spacing between poles in an effort to reduce costs.

To answer Mr. Wyatt's comments. I would again like to emphasize that the cost analysis in this paper was prepared for a shopping center parking area. Certainly the E-H1 lamp is more efficient than the J-H1 lamp and a majority of the early shopping centers were lighted with this source. However, since the advent of the J-H1 and the larger wattage fluorescent mercury sources the trend throughout most parts of the country seems to be toward the fluorescent mercury lamp for this application.

I would like to correct Mr. Wyatt's statement that this paper has recommended 1.3 to 1.6 footcandles for shopping center areas. A glance at Table II shows a range of from 0.8 to 2.0 footcandles for this application. As stated in the text the lower figure was considered a minimum from the safety viewpoint. The higher figure was not intended to be a maximum but as stated was based on current good practice. In the parking area 5.0 footcandles would be excellent. However, figures available to the author show a general practice throughout the country of installations providing from 0.8 to 1.5 footcandles. The author feels that a general trend to 5.0 footcandles in the shopping center, while perhaps desirable, is something that is going to require some time to achieve.

Recessed Lighting—To Keep the Records Straight

About 72,000 active accounts of registered Herefords are accommodated in the records room of the new headquarters building of the American Hereford Association, Kansas City, Mo. Here, as in other areas of the new building, the recessed troffers were specially constructed to occupy a minimum depth. The two- and three-lamp, 96-inch, 430-ma units are equipped with double Fresnel type lens panels, and are mounted in an off-white acoustical tile ceiling at a height of 12 feet, on five-foot centers. Average illumination is 60 footcandles. Photo and data courtesy of Sunbeam Lighting Co., Los Angeles, Calif.

INSTALLATION AT BOWMAN HILL TOWER, WASHINGTON CROSSING, STATE PARK, PENNSYLVANIA.

Floodlighting a Tower

LIGHTING OBJECTIVE: To floodlight a tower calling attention to its beauty and location at night.

GENERAL INFORMATION: This tower, located in a Pennsylvania State Park, is a historical landmark currently used as an observation tower. It is built of native field stone (25 per cent reflectance), 25 feet square at its base and 110 feet high.

INSTALLATION: The tower is illuminated by sixteen Westinghouse VRC-18 floodlights, each using a 1000-watt PS-52 clear lamp, located on the ground 36 feet from the tower as shown in Fig. 2.

(over)

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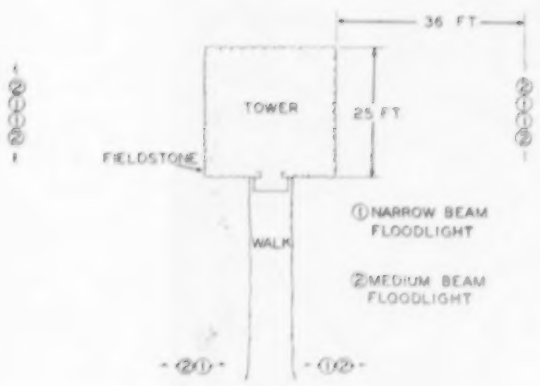

Figure 2. Plan view.

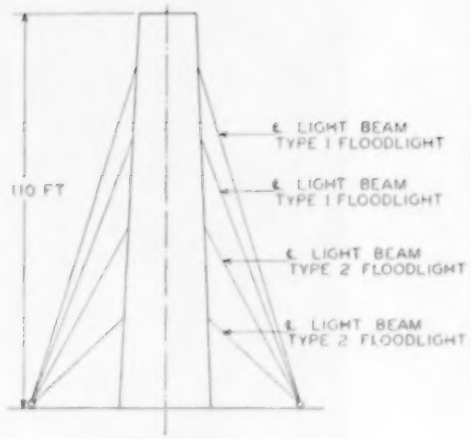
110 FT
℄ LIGHT BEAM TYPE 1 FLOODLIGHT
℄ LIGHT BEAM TYPE 1 FLOODLIGHT
℄ LIGHT BEAM TYPE 2 FLOODLIGHT
℄ LIGHT BEAM TYPE 2 FLOODLIGHT

Figure 3. Elevation of tower.

There are two types of floodlights:

(1) Style No. 1569 749 with narrow-beam specular reflector and a narrow-beam plain lens.
(2) Style No. 1569 751 with narrow-beam specular reflector and a narrow-beam spread lens.

The center line of the light beams are directed upward as shown in Fig. 3. The illumination is approximately 9 footcandles on the tower.

Lighting designed by William G. Speed ,Lighting Engineer, Philadelphia Electric Company, 1015 Chestnut Street, Philadelphia, Pennsylvania.

Lighting data submitted by George T. Anderson, Jr., Philadelphia Electric Company, 1015 Chestnut Street, Philadelphia, Pennsylvania as an illustration of good lighting practice and to aid in the design of similar installations.

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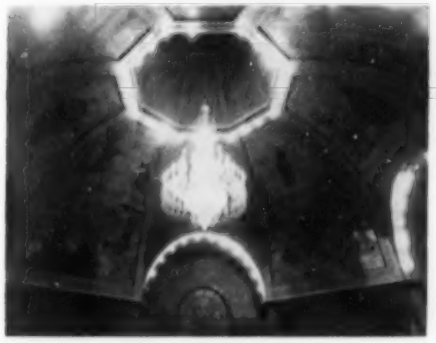
Beauty of murals is displayed by adequate and well-designed lighting, above; as compared with dingy appearance and glaring lamps, below.



Mural Lighting In a Church Dome

By WALTER S. GREENWOOD

PROPER lighting of the large murals in the dome of the Three Saints Russian Orthodox Church, Garfield, N. J., is essential to bring out all the beauty of the paintings of Biblical events. By the use of concealed light sources and careful planning, this was accomplished at a reasonable expense.

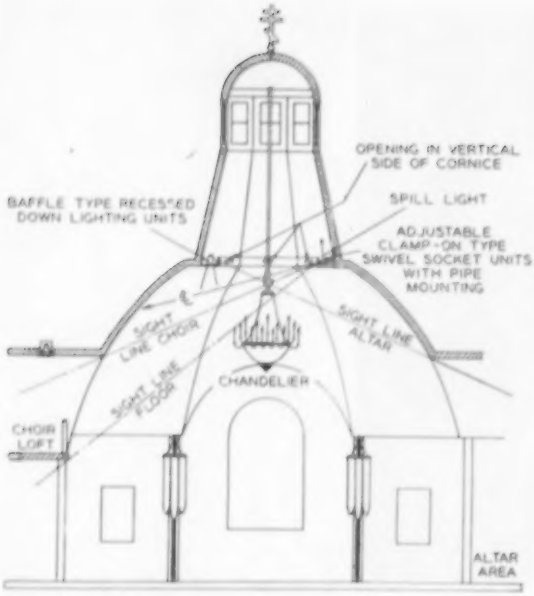
Originally the church was lighted by rows of exposed incandescent lamps at the top of the dome and over the arches, as shown in the "before" photo. These bare lamps were glaring and did little to provide illumination on the murals. A large chandelier equipped with over-sized flame-shaped lamps supplied still more glare, and an accumulation of dust gathered over many years further obscured the murals.

When the building committee decided that the church interior was to be redecorated, they realized that in addition to cleaning the paintings it was necessary to improve the lighting system.

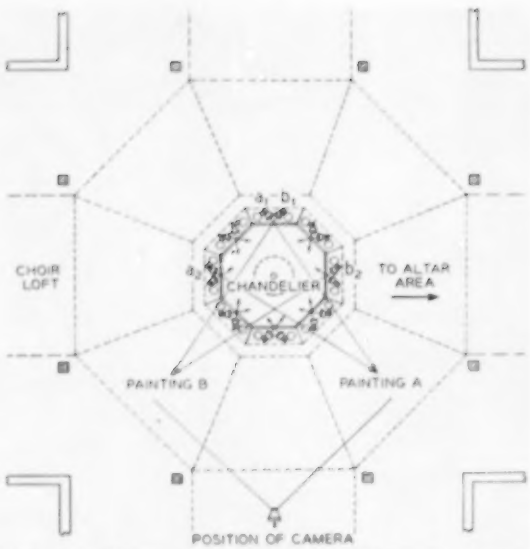
After consideration of a number of methods, it was decided to build a cornice 15 inches wide and 9 inches deep at the top of the dome, as shown in the elevation drawing. The lighting units are concealed behind the cornice, projecting their light through openings in the vertical sides toward the murals. The cornice also conceals the baffle-type downlights which provide light for the floor of the church.

Originally the intention was to direct the light for the murals straight across the dome, but this would have produced objectionable shadows of the chandelier on the opposite walls. Therefore, the

AUTHOR: Lighting Representative, Public Service Electric and Gas Co., Passaic, N. J. This entry won second prize at the I.E.S. Northwestern Regional Conference, after having been awarded first prize in the New York Section's contest for My Most Interesting Lighting Job.



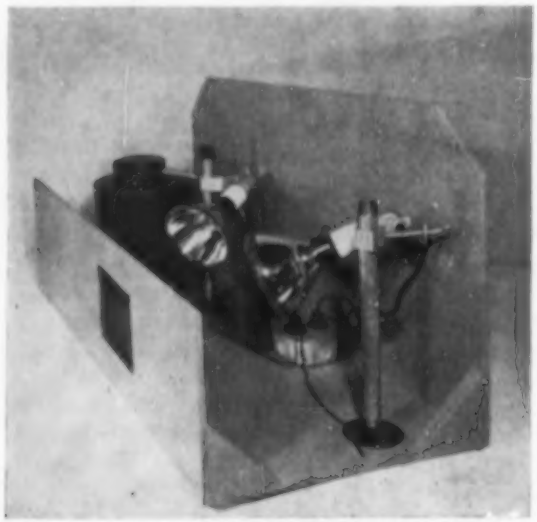
Elevation of dome area shows sight lines from altar area, choir and floor. Apertures in cornice are barely visible.



Plan view shows aiming of units, diagonally across dome, so that each painting is illuminated from two directions.

light is directed to the diagonally opposite walls, to avoid such shadows. With this diagonal aiming, each mural is lighted from two directions, by units behind two different openings. For example, painting "A" receives light from units "a_1" and "a_2" and painting "B" receives light from units "b_1" and "b_2" as illustrated in the plan view drawing.

A method was developed to mount the units so that they are adjustable in height as well as in direction. A full-sized model of the section of the cornice was constructed. A short length of pipe is fastened in place by a flange and the 150-watt PAR-38 projector spot lamp is mounted on the pipe with clamp-on type swivel socket unit, at any desired height. The unit may then be adjusted to direct the maximum amount of light through the opening toward the mural. As arranged, the converging light rays cross at a point 14 inches from the light center. The dimensions of the cornice were selected to provide a distance of approximately 14 inches from the light center of the lamp to the opening in the vertical side. Under these conditions the maximum amount of light will pass through the 4½ x 6-inch opening. In fact, such a small quantity of light is intercepted by the edges of the opening that the resulting pattern of light is circular, not rectangular as might be expected, and the coverage of the paintings is remarkably uniform.



Full-scale model of cornice section was constructed to determine the exact mounting height and aiming of projector spots that would direct the maximum amount of light through the openings toward the murals.

The effectiveness of the installation is shown in the "after" photo. The mural lighting units are concealed, even from choir or altar areas, and it is difficult to see the rectangular openings. The brightness pattern is pleasing and glare has been minimized. The cupola is illuminated by spill light from the top of the cornice and the candles of the chandelier have been equipped with small natural-sized candle flame lamps. Sixteen cylindrical baffle-type downlights, recessed in the cornice, using 150-watt R40 reflector spot lamps provide adequate illumination on the floor.

A Brightness Meter for Use in Model Studies of Buildings

By E. E. VEZEY

SINCE the beginning of illumination studies by the Texas Engineering Station through the use of models in 1951,[1,2,3] the need has been felt for a brightness meter suitable for such work. For use in model studies of illumination, the meter should be compact and have a range from about two footlamberts to about 120 footlamberts. This range is covered with excellent precision by brightness meters now on the market, such as the Luckiesh-Taylor[4] Brightness Meter and the Spectra Brightness Spot Meter,[5] but these meters are designed for full-scale buildings and occupy too much volume for illumination studies in models.

AUTHOR: Research Physicist, Texas Engineering Experiment Station, Texas A. & M. College System, College Station, Texas.

With these limitations in mind, a brightness meter suitable for measuring brightness ratios in model studies of daylight has been devised by the Texas Engineering Experiment Station. It is simple in construction, compact and has sufficient sensitivity for the low brightness intensities found in models.

Fig. 1 shows a section through the meter. The tube B houses the collimating device C and the barrier layer cell A.

The collimator is constructed of a number of thin metal disks each perforated by 88 1/8-inch holes. The disks are separated by wire ring spacers and aligned so that the holes form 88 circular apertures, each having a field of view of 5.73 degrees. The holes are staggered and are separated 5/16 inch on centers. The area of the holes is 38 per cent of the area of the barrier layer cell. The disks are painted matte black to prevent the light, which makes an angle of more than 2.86 degrees with the axis of the holes, from reaching the barrier layer cell by reflection from the edge of the holes.

Fig. 2 is an end view of the collimating device.

The sensitivity of the meter, when used with a galvanometer having a sensitivity of 0.008 microamperes per millimeter at a distance of one meter, is sufficient to measure brightness values of 2.0

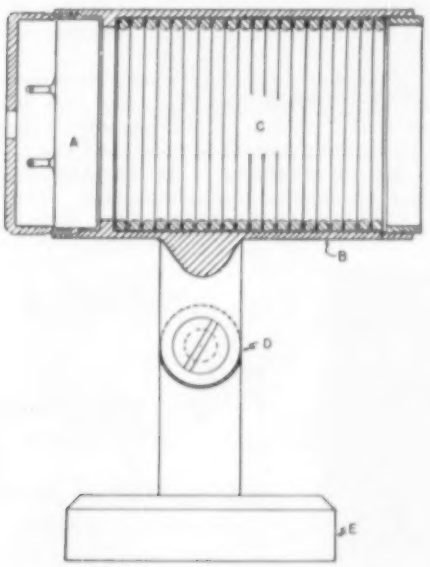


Figure 1. (above).

Figure 2. (left).

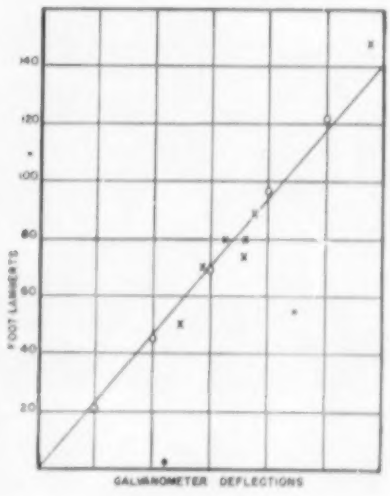


Figure 2. (right) Meter response — points indicated with a circle were obtained by the use of a photometer, while points marked by an "X" were determined against a Spectra Brightness Spot Meter.

footlamberts to within ±25 per cent. At a brightness of 20 footlamberts the accuracy is approximately ±5 per cent.

The response of the meter is linear with respect to brightness as indicated by Fig. 3. The response of the meter at different distances from a uniformly bright surface is constant.

The field of view covered by the meter is 2.5 inches in diameter when the end of the collimator is placed 6 inches from the source.

It is possible to increase the sensitivity of the meter by spacing the ⅛-inch holes on $\frac{5}{32}$-inch centers instead of on $\frac{3}{16}$-inch centers. This increases the effective area of the barrier layer cell from 38 per cent to 54 per cent.

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Lighting Designed for Human Comfort—Recommended Levels—Ease of Maintenance

Last year St. Luke's Hospital, Cleveland, handled a total of 24,438 cases. While probably none of these patients was happy to be included in the number, their treatment period was made as comfortable as pleasant surroundings could make it. The emergency room area is completely air-conditioned and acoustically treated. The lighting has been planned throughout with thought to the horizontal patient, who is already in discomfort.

The emergency room is an area capable of handling up to twenty patients at a time, when used as one large room, and can also be converted into four small treatment rooms by means of partitions. The lighting system consists of four 4-foot and one 6-foot two-lamp recessed troffers, with glass bottoms, in each bay, installed in a "U" over the treatment tables with the open end over the patient's head. The lamps are 48-inch de luxe warm white, chosen for their color. The installation provides an average of 60 footcandles, and a 100-watt surgical lamp over each table supplies several hundred footcandles for actual treatment. The recessed troffers were selected for their ease of maintenance and because they are not likely to allow dust to fall into the treatment area.

The same recessed units are used throughout the waiting room and corridors, supplying over 50 footcandles, so that, in case of disaster, patients could be given emergency treatment in these areas also.

The lighting installation is by Theodore Ake, Jr., Cleveland Electric Illuminating Company.

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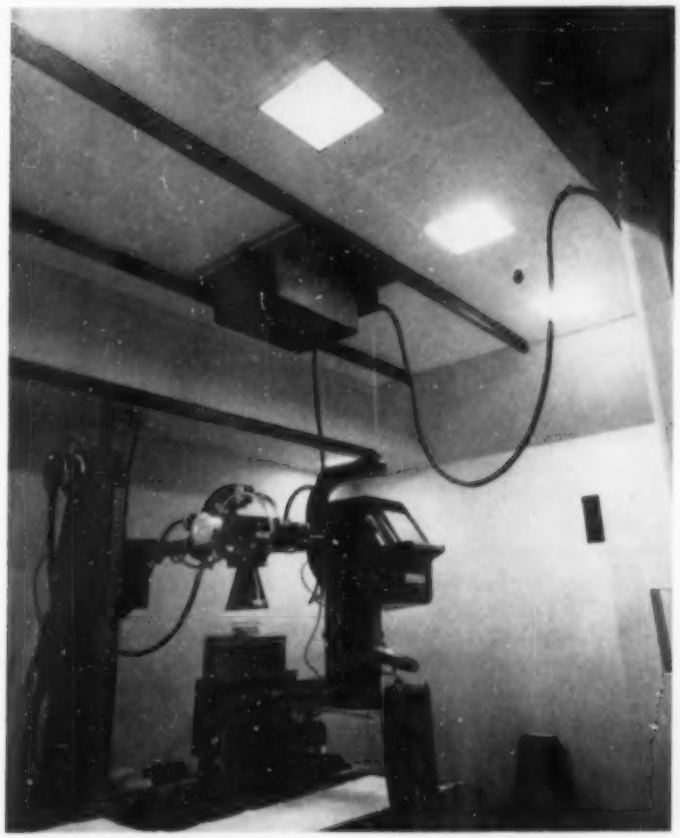

INSTALLATION IN OFFICE OF DR. PHILIP PARILLO,
1494 WENDELL AVE., SCHENECTADY, N. Y.

Lighting an X-Ray Fluoroscope Room

LIGHTING OBJECTIVE: To provide four levels of suitable illumination in an X-ray fluoroscope room for setting up and screen viewing.

GENERAL INFORMATION: The room shown above measures 11 feet 9 inches by 16 feet, ceiling height is 10 feet except where the X-ray machine moves horizontally in a 2-foot deep cavity recessed in the ceiling (see Fig. 2). Surface characteristics are as follows:

ceiling, acoustical tile	white	75% RF
walls	peach	35% RF
floor, rubber tile	gray	10% RF
machine	black enamel	5% RF

Incandescent light sources were chosen for this installation since X-ray and fluoroscope technicians do not approve of the use of fluorescent light sources in the X-ray room. They state that for some operations they must dark-adapt their eyes in order to study minute details of the fluoroscope screen and feel that the phosphor retentivity of the fluorescent tubes gives a sense of interference when lights are switched off. Also, under certain conditions stray radiation from the X-ray machine may activate the phosphors of the fluorescent lamps enough to cause disconcerting fluorescence of the lamps in a darkened room.

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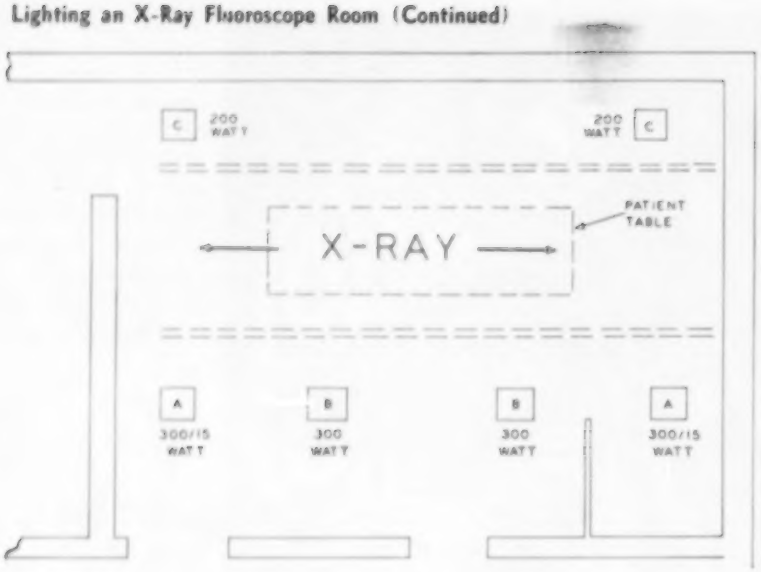

Figure 2. Plan view.

INSTALLATION: Six Kirlin Company catalog No. 1212 units with 12¼-inch heat-resisting wide spread lenses are recessed in the ceiling. As shown in Fig. 2, two units use 200-watt PS-30 inside frosted general service lamps and four units use 300-watt PS-30 inside frosted general service lamps, with the outer two units equipped with a special second socket and 15-watt incandescent lamp for "dim light" viewing.

The circuits were designed to provide four different levels of lighting, each circuit being controlled by an individual wall switch. Lighting levels are as follows:

Units in Operation	Illumination Table
15-watt A	1 ft-c
15-watt A and C	5 ft-c
300-watt A and C	20 ft-c
15-watt A, 300-watt A, B and C	35 ft-c

Approximate brightness under highest level:

Table	21 ft-L
Walls	10 ft-L
Floor	3 ft-L

Lighting designed by Randall H. Rice, Lighting Sales Engineer, Westinghouse Electric Corp.; Electrical Contractor: Michael Larciprete, 1703 Van Vranken Ave., Schenectady, N. Y.

Lighting data submitted by Randall H. Rice, Westinghouse Electric Corp., 19 Railroad Ave., Albany, N. Y. as an illustration of good lighting practice and to aid in the design of similar installations.

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Graphical Determination of Illumination By Solid Angle Projection Methods

By JOHN O. KRAEHENBUEHL

THE PRESENT system of photometric nomenclature and calculations is based upon the definition of luminous flux. The mathematical expression for this concept is,

$$I = F/\omega \qquad (1)$$

where I is the luminous intensity, F the luminous flux, and ω is the solid angle. The assumption is that the intensity originates at a point source, which assumption has been brought under severe criticism by those who wish to tie the basic concepts to the spectroradiometric considerations.

Since at present, this is only a contention, and the above is the basic accepted consideration in illumination and engineering practice, it is necessary to determine the value of ω in making illumination calculations. The illumination may be determined from the following:

$$E = F/A \qquad (2)$$

where E is the illumination, F the luminous flux and A the area subtended by the solid angle. Combining the two expressions, 1 and 2,

$$E = I\omega/A \qquad (3)$$

If the average luminous intensity is obtained from the test data of the luminaire and the area to be illuminated is determined it is only necessary to find some simple method of obtaining the solid angle (ω) to calculate the average illumination.

A graphical method for determining the value of the solid angle is developed in this paper. The methods of the cartographer are used and the graph paper for making the solution, in graphical form, may be obtained from any supplier of cartographic material or may be constructed as outlined in Appendix B. Also the nomenclature of the cartographer will be used.

The practicing engineer seeks methods that are easy to apply and that give a final solution under any condition for any problem. The material presents a method of solving differential equations which cannot be solved by academic methods, with the degree of accuracy desired by the engineer. By large scale drawings and by choosing small enough increments of solid angle a solution may be obtained for any shape and for any surface with any non-uniform brightness because of asymmetric light distribution from the source.

Fig. 1 shows a surface A which is subtended by the solid angle ω where any point P in the perifery of the area has a latitude α and a longitude β. The complete perifery may be determined by these two parameters or if the luminous intensity to the area is not uniform, any portion which may be exposed to a uniform luminous intensity may be so considered. It is necessary to make a table of the significant points, and as many others as necessary, to allow later plotting of the projected surface.

Since it is impossible to represent a sphere on a plane surface without either distorting the angle or the projected area a graphical form must be selected for plotting the true area, for the solid angle is defined by the projected area on a sphere with a unit radius. The cartographer has developed two forms of equal-area projection paper, the "sinusoidal equal-area projection" and the "cylindrical equal-area projection," either of which may be used depending upon the preference of the engineer.

It is only necessary to plot the data from the table of latitudes and longitudes upon either of these graph papers to obtain the true area in the sphere surface of the subtended area. As is shown under Example 1, in Appendix A, where the graph paper web covers one-eighth of a sphere, representing $\pi/2$ steradians—units of solid angle—the solid angle (ω) may be obtained by a ratio of the projected area to the area of the web, both in square inches, multiplied by $\pi/2$. When the solid angle has been determined the illumination may be calculated using equation (3) after I and A have been determined. An examination of the simple example in Appendix A demonstrates the principles used in making a solution.

As the problems become more complicated more points are involved on the perifery or in the area

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 12-16, 1955, Cleveland, Ohio. AUTHOR: Department of Electrical Engineering, University of Illinois, Urbana, Ill.

for making a solution; the task does not become more difficult but more tedious with the complication. Example 1 is the solution of an apparent point source or one in which the average distance to the surface is at least five times the greatest dimension of the light source.

The method, if not the actual use of the same type of graph paper, is equally applicable to surface sources which may be classified as any source which cannot be reduced to an apparent point source. Fig. 2 shows a surface source A with a point (P) on the perifery described by the latitude α and longitude β. The surface outline is projected on a sphere with radius R and the projected surface on the sphere is projected to the plane XY. It is this projected area on the plane XY which is important in the determination of the illumination.

To determine the illumination at o, the point under consideration, from the surface A with a brightness B.

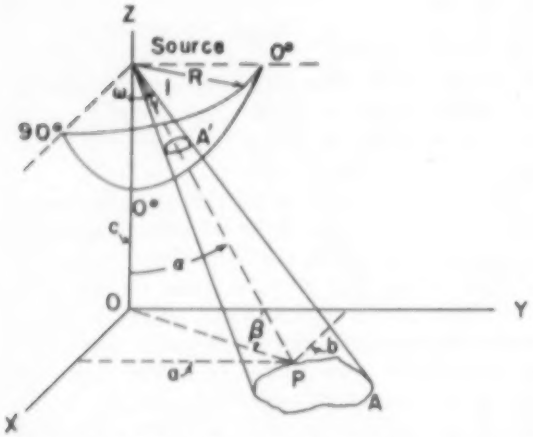

Figure 1. Solid angle projection from an apparent point source.

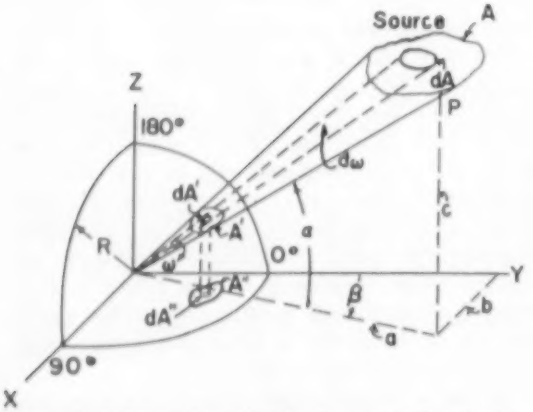

Figure 2. Solid angle projection from a surface source.

$$dA' = R^2\, d\omega$$

$$dI = BR^2\, d\omega$$

$$dE = \frac{dI \cos\theta}{R^2} = \frac{BR^2 \cos\theta\, d\omega}{R^2}$$

$$dA'' = dA' \cos\theta = R^2\, d\omega \cos\theta$$

$$dE = B\, dA''$$

where $E = B \int_a dA''$ if the brightness is constant,

and $E = \int_a B\, dA''$ if it is not constant.

To solve the problem by graphical methods, it is necessary as before, to prepare a table of latitudes and longitudes and to choose the correct cartographic paper for plotting the values. The projection is not upon a sphere but upon a plane, however; the latitude lines and the longitude lines from the sphere must be projected upon a plane surface. If all components of the illumination are desired the graph papers chosen must consider all three planes. The projection paper for the XY *plane* is called "orthographic polar projection" paper and that used for the projections on the XZ and YZ planes is called "orthographic equatorial projection paper."

As before the projected area is located on these graph papers by means of latitude and longitude and the area must be determined in square feet. If the area is measured in square inches it is necessary to use a correction factor which is the reciprocal of the square of the radius in inches or $K = 1/R^2$.

The illumination will then be the product of the square feet of the projected area times the brightness of the surface in candles per square foot. If the surface does not have a uniform brightness it is only necessary to break it into as many areas as can be considered to have a uniform brightness and proceed in the same manner as before. Regardless of the problem it will always be necessary to draw the limiting perifery. If first the significant points are located it will be much easier to determine the number of points necessary to draw a good outline of the projected area.

Papers on this same subject have appeared under the title of "unit sphere method." These usually have been academic with little the engineer could use except in those instances where the surface was of simple geometric form. By analytical methods any surface bounded by straight lines can be solved, but only a few of those bounded by curved lines have been solved to the present time. This paper is written using the older nomenclature of "solid angle projection" because it definitely describes the process and it is not necesary to use a sphere of unit radius. The concept was first intro-

duced by Lambert and many uses have been made of the method in daylight calculations but no extended use has been made of solid angle projection in artificial lighting.

Appendix A — Examples

In the determination of the solid angle subtended by an area it is necessary to obtain the angles of latitude and longitude. These are obtained from the expressions:

$$\alpha = \tan^{-1} \frac{(a^2 + b^2)^{1/2}}{c} \qquad \text{latitude}$$

$$\beta = \tan^{-1} \quad b/a \qquad \text{longitude}$$

after solving for the values of the tangents the angles may be determined from a set of tables. For those not acquainted with this simple procedure it is only necessary to lay out the values of a, b, and c on a drawing board and measure the angles with a protractor. For engineering purposes this will prove accurate enough and any error will compare with the others introduced by practical considerations.

TABLE I

Point	Longitude Degrees (β)	Latitude Degrees (α)	Point	Longitude Degrees (β)	Latitude Degrees (α)
a	0	180	cd_2	40	139
b	0	132	cd_3	50	144
be_1	10	131.5	cd_4	60	148
be_2	20	130	cd_5	70	150
e	37	129	cd_6	80	151
cd_1	30	132	d	90	152

Example 1. To determine the average illumination on an area as shown in Fig. 3 when the average luminous intensity of the source is 2000 candles.

Determine the latitude and longitude for locating the significant points a, b, c, d and then intermediate points for drawing a smooth curve as shown in Figs. 4 and 5. Table I gives the values of latitude and longitude as determined. With these data the projection is drawn on either of the equal-area webs and the solid angles may be determined.

Fig. 4. The solid angle in steradians is:

$$\omega = \frac{\pi}{2} \times \frac{5.54}{15.91} = 0.547$$

Fig. 5.

$$\omega = \frac{\pi}{2} \times \frac{12.18}{35.00} = 0.547$$

$$E = \frac{2000 \times 0.547}{10 \times 10} = 11.9 \text{ footcandles.}$$

This type of solution may be applied to irregular shaped parking lots and street intersections, even those which are not square or rectangular in shape.

This problem could have been solved by analytical methods by

$$\omega = \tan^{-1} \frac{xy}{z(x^2 + y^2 + z^2)^{1/2}}$$

When using this form the solid angle will be 0.548. The solution using graphical solid angle projection is within one part in 548, accurate enough for all engineering purposes. The analytical solution was made with a five place trigometric table and the angles in Table I were read from a plotted graph except the points a, b, c and d which were calculated with a slide rule.

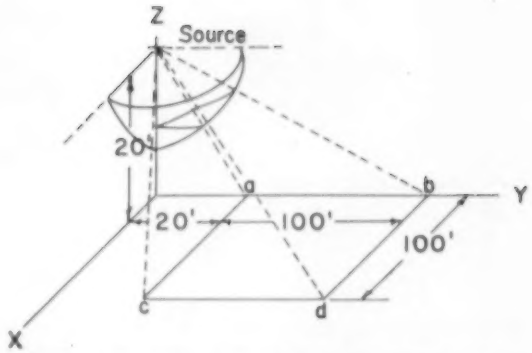

Figure 3. An example of solid angle projection from an apparent point source.

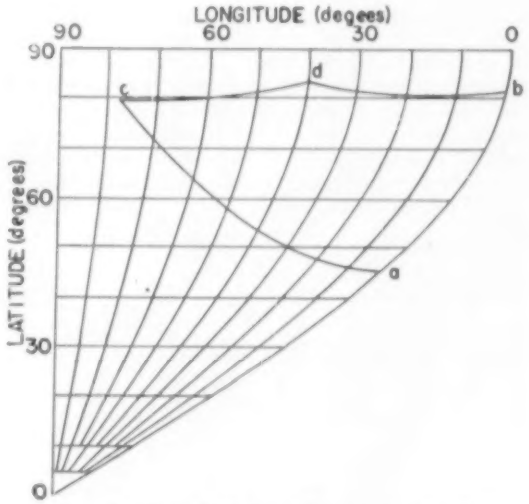

Figure 4. Sinusoidal equal-area projection for Example 1.

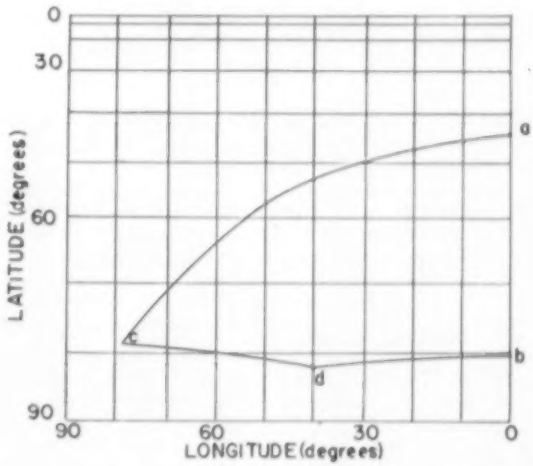

Figure 5. Cylindrical equal-area projection for Example 1.

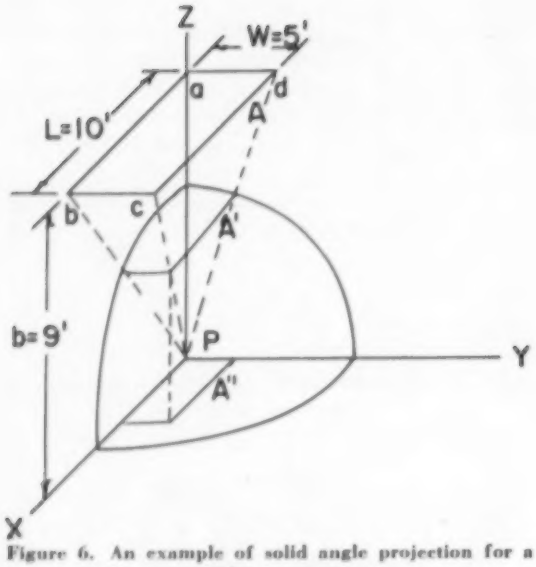

Figure 6. An example of solid angle projection for a surface source.

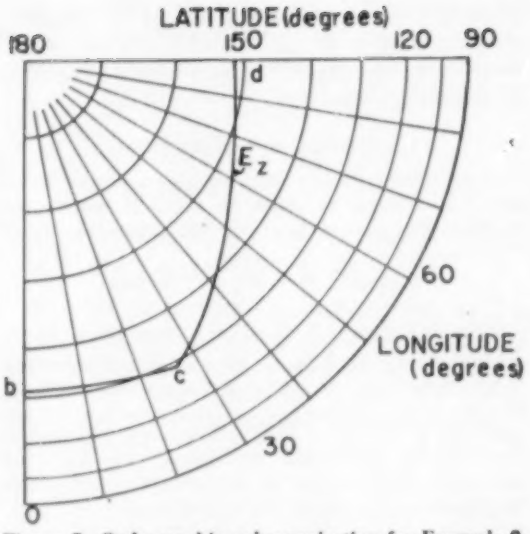

Figure 7. Orthographic polar projection for Example 2.

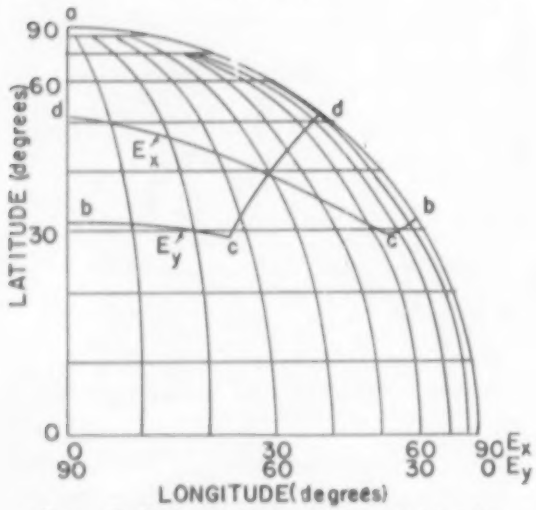

Figure 8. Orthographic equatorial pojection for Example 2.

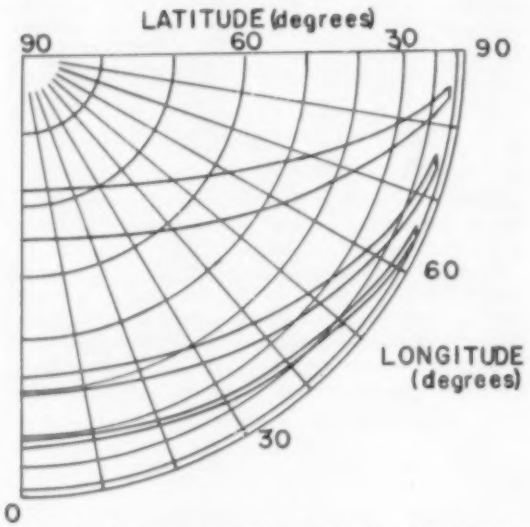

Figure 9. Orthographic polar projection for an array of sources.

Example 2. To determine the illumination at point P from the rectangular source shown in Fig. 6. The source has a brightness of 200 footlamberts.

The latitude and longitude are determined from the relationships,

$$\alpha = \tan^{-1} \quad c/a \qquad \text{latitude}$$
$$\beta = \tan^{-1} \quad b/(a^2 + b^2)^{1/2} \qquad \text{longitude}$$

TABLE II

Point	Longitude Degrees (β)	Latitude Degrees (α)	Point	Longitude Degrees (β)	Latitude Degrees (α)
a	0	45	c	78.8	79
ac_1	15	46	cd_1	65	79.9
ac_2	30	49	cd_2	55	80.9
ac_3	40	52.5	d	39.3	82.8
ac_4	50	57.5	db_1	35	82.2
ac_5	60	63.5	db_2	25	81.5
ac_6	70	71.0	db_3	15	81.0
ac_7	75	75.5	b	0	80.6

with reference to Fig. 2. The values for the problem are listed in Table II. These data are plotted on "orthographic polar projection" paper for E_z and on the "orthographic equatorial projection" paper for the values E_x and E_y. It will be noted that the angular longitude spacing has been reversed on the graph for the X and Y respectively. The three areas are plotted on graph paper which has a radius of 6.324 inches making the conversion factor $^1/_{40}$ for changing the square inches to square feet. Table III gives the results for the solution of the problem where B is $200/\pi$ or 63.66 candles per square foot.

TABLE III

Illumination Components	Figure	Square Inches	Illumination Brightness (B)	Graphical	Analytical
E_x	8	3.28	0.0820B	5.2 ft-c	5.2 ft-c
E_y	8	5.42	0.1335B	8.5	8.6
E_z	7	12.76	0.3190B	20.3	20.4

The analytical solution was obtained from the following expressions:

$$E_x = \frac{B}{2}\left(\sin^{-1}\frac{L}{(L^2+b^2)^{\frac{1}{2}}} - \frac{b}{(b^2+W^2)^{\frac{1}{2}}}\sin^{-1}\frac{L}{(b^2+L^2+W^2)^{\frac{1}{2}}}\right)$$

$$E_y = \frac{B}{2}\left(\sin^{-1}\frac{W}{(b^2+W^2)^{\frac{1}{2}}} - \frac{b}{(b^2+L^2)^{\frac{1}{2}}}\sin^{-1}\frac{W}{(b^2+L^2+W^2)^{\frac{1}{2}}}\right)$$

$$E_z = \frac{B}{2}\left(\frac{W}{(b^2+W^2)^{\frac{1}{2}}}\sin^{-1}\frac{L}{(b^2+L^2+W^2)^{\frac{1}{2}}} + \frac{L}{(b^2+L^2)^{\frac{1}{2}}}\sin^{-1}\frac{W}{(b^2+L^2+W^2)^{\frac{1}{2}}}\right)$$

where B is in candles per square foot and the other values from Fig. 6.

Fig. 9 shows the projected array of luminous elements when the illumination was determined at working height in one of the corners of the room. Details are not given for this problem because of limited space but it indicates the possibility of using the method upon a complete lighting system.

Once the components are given the usual methods of determining the illumination on any plane in any position may be followed.

Appendix B — Construction of Graph Paper

When purchasing graph paper one is limited to definite sizes. A high degree of accuracy may be obtained when the radius of the sphere is one foot and with a factor of $^1/_{144}$, reducing the effect of any error in making area determinations.

Sinusoidal Equal-Area Projection — The method of construction is shown in Fig. 10a. Usually the equator — representing 180 degrees — is divided into steps of 10 degrees each, bearing marks, with 5-degree steps in between but not marked. From the pole to the equator is one-half the distance along the equator, therefore, the web can be inserted into a semi-circle. For each desired division in longitude a circle is drawn, as shown in the upper portion of the figures, and these circles are divided into circular arcs corresponding to divisions in degrees taken in latitude, which latitude lines will be equally spaced horizontal lines on the diagram. If the distance from the equator is marked off in 10-degree steps, correspondingly the arcs should be divided into 10-degree angles. The intersection of the arcs and radial lines, on the web, locates the points through which the longitudinal lines are drawn. In the figure the extreme longitudes 0 and 180 degrees have been drawn with one longitude line showing details of construction.

In the usual cartographic projections the latitude is measured from the equator and indicated as north and south. However, following the practice of previous papers in the Society's publications and committee reports on street and highway lighting, the latitude is measured from nadir making the equator 90 degrees and the zenith 180 degrees on the latitude scale.

Cylindrical Equal-Area Projection — This construction is shown in Fig. 10b and is much simpler than the sinusoidal. The base line for longitude is divided into equal parts from 0 to 180 degrees, and the latitude from 90 to 180 degrees, the upper half of the hemisphere, is divided according to the sine of the angle. This corresponds to the sinusoidal equal-area projection shown in Fig. 10a. The construction semi-circles are divided into arcs corresponding to the degree divisions which should appear on the finished web. Project the intersection of the radial lines and the arc upon the coordinate system.

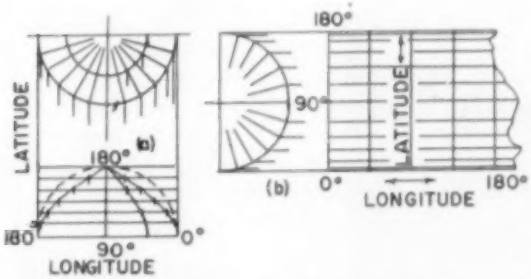

Figure 10. Construction of graph paper for a sinusoidal equal-area projection (a) and for a cylindrical equal-area projection (b).

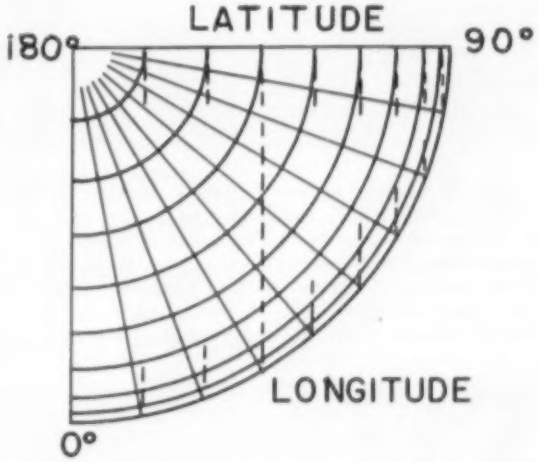

Figure 11. Construction of graph paper for an orthographic polar projection.

Orthographic Polar Projection — This construction is shown in Fig. 11. Here the radial lines are drawn, on the construction circle, at equal angles, also on the web. The arcs for the web are obtained in a manner similar to the procedure for the cylindrical equal-area projection.

This one web could be used for all three components by proper orientation of the figure for a problem but in each instance it would be necessary to determine a set of latitude and longitude values. By the construction of another web it is possible to use the same table of latitude and longitude for all projections.

Orthographic Equatorial Projection — Fig. 12 shows the construction of the web. The latitude lines are straight, but not equally spaced and the longitude lines are curved.

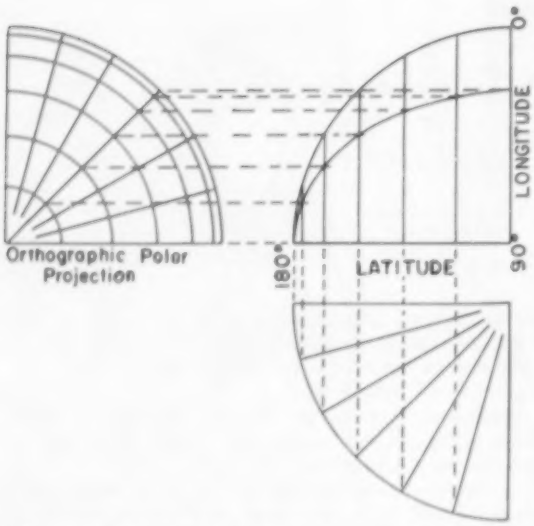

Figure 12. Construction of graph paper for an orthographic equatorial projection.

Points are projected from the orthographic polar projection and a radial line projection, both being divided into the same number of equal angles. The projected lines from the two construction diagrams intersect at the points on the web for the longitude lines, the latitude lines are drawn from the radial projection.

Though the webs have been confined to a portion of the hemisphere it is possible to construct the web for the whole hemisphere. In practice only one-eighth of the sphere surface need be considered for the usual installation has symmetry and by the proper selection of coordinate axes the desired portion may be projected upon the limited web with the final results obtained by considering the projection the correct number of times.

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Cove Lighting in a Masonic Lodge

General lighting in the Lexington Masonic Lodge Hall, El Monte, Calif., is provided by a cove, designed to the specifications of Del Reynolds, Southern California Edison, whose entry it was in the Southern California Section's contest for My Most Interesting Lighting Job. Four continuous rows of overlapping 8-foot slimline fluorescent lamps, wired for dimming are used in the cove. The pillars in the background are rose-colored translucent panels illuminated from inside the base with R40 floods. Downlights highlight the podium and central altar.

The Grand Master of the Lodge was also the electrical contractor for the installation — Parker Electric Company.

INSTALLATION IN CLEVELAND, OHIO.

A Luminous Ceiling in A Traditional Kitchen-Dinette

LIGHTING OBJECTIVE: (1) To provide recommended levels of comfortable lighting for efficient performance of household tasks (2) to enhance the beauty of handwrought furnishings and mellowed wood tones.

GENERAL INFORMATION: Kitchen is 10 x 14 feet and dinette 8 x 12 feet with 8-foot ceiling common to both. Kitchen window wall with built-in charcoal broiler, range surface units and two ovens, is of buff-colored brick (40% reflectance). Cabinets are of natural knotty pine (40% reflectance). A Williamsburg print (about 50% reflectance) is used in the dinette, and on the end wall of the kitchen, above a wainscotting of black tile. Counter tops are of coral laminated plastic (50% reflectance) and the wall above counters and sink is of opaque structural glass. The floor in both rooms is of dark grey and coral slate slabs (about 15% reflectance). In the dinette the frame of the undraped window is coral red, matching the chair seats.

INSTALLATION: Twelve inches below the white plasterboard ceiling are 2 x 4-inch hand-adzed beams on 3-foot centers, finished with a brown stain. These support the corrugated vinyl plastic (Marlux) which runs the entire length of the kitchen and dinette as well as the 10 x 14-foot utility room (not shown). On the ceiling above the plastic are mounted seven 40-watt and six 30-watt

(over)

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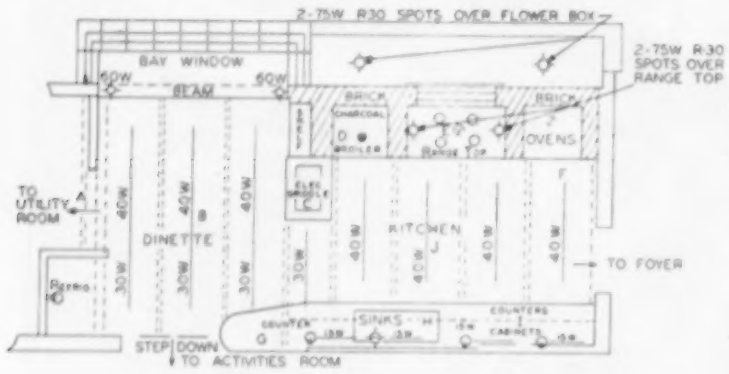


Figure 2. Plan view of kitchen-dinette.

Illumination Measurements (All readings taken 36 inches above floor)

Location See Figure 2	Luminous ceiling only	Luminous ceiling plus local lighting
A	20 ft-c	
B	25 ft-c	
C	25 ft-c	
D	10 ft-c	
E	12 ft-c	50 ft-c
F	15 ft-c	25 ft-c
G	20 ft-c	35 ft-c
H	20 ft-c	38 ft-c
I	20 ft-c	35 ft-c
J	25 ft-c	

Deluxe Warm White fluorescent lamps in channel strip (Virden), located as indicated on the sketch. The rows of lamps are centered between the beams.

The beams serve not only to support the plastic, but to preserve the traditional feeling of the home as well. They also provide visual shielding, which is particularly important here, since from either end of the Kitchen-Dinette-Utility area a 36-foot long expanse of luminous ceiling would otherwise be visible.

Local lighting is provided over the range by two 75-watt R-30 spot lamps. These are mounted in the brick arch at such an angle that their beams fall obliquely upon the stainless steel surfaces, thus minimizing specular reflections and providing 50 footcandles at work level.

The counters and sink on the opposite wall are lighted by four individually controlled 15-watt Deluxe Warm lamps mounted on the wall directly beneath the upper cabinets. These provide from 15 to 20 footcandles at the center of the counters. The addition of the general lighting increases this to between 35 and 40 footcandles.

In the dinette the general lighting follows the same general pattern as in the kitchen, and with the same result — 20 to 25 footcandles on a 30-inch horizontal plane. The two-foot bay has a steeply-slanted ceiling and a 4-inch horizontal beam at the edge of the luminous-ceiling area. This beam helps to cut down ceiling reflections in the window so that no glass curtains are needed.

Decorative lighting touches are supplied in the dinette by the pair of bright copper wall lanterns (60 watts each) and the table lamp of traditional design which serves as a fruit and flower bowl as well. Also visible through the bay windows are the outdoor flower boxes which are lighted by recessed 75-watt R-30 spot lamps.

CONCLUSION: In the rooms described, the change from light to darker areas and from high to low reflectance is so gradual that one is not conscious of the light sources either while in the rooms or when looking into them from adjoining areas. Comfort efficiency and gracious living are offered in a combination satisfying to particular people.

Builder: George Postlethwait, Cleveland, Ohio.

Lighting data submitted by Charlene Reed, The Illuminating Company, Cleveland, Ohio, as an illustration of good lighting practice and an aid to the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

11-55

Signboard Lighting Economics

By W. H. JOHNSON

THE USE OF outdoor signboards for advertising is one of the simplest, most effective ways of reaching the general public that has been found. Millions of people travel our roads and walk our sidewalks every day passing and repassing conveniently located signboards. Other millions traverse these same roads and walks during the hours of darkness, and by the simple process of illuminating the signboard, the market for its advertising is tremendously increased. Good application data for intelligently lighting these boards is, however, very limited.

The Basic Signboard

Signboards come in a great variety of shapes and sizes, but the one board which is far more common than the rest is the standard 24-sheet poster board. This board is basically an advertising space 24 feet wide and 12 feet high. It may be trimmed or framed in any number of ways and may be constructed of wood, metal or plastic but the amount of advertising space is still 24 ft by 12 ft. This paper is directly concerned with an analysis of only this size of board, but the relative economics will also often be applicable to other sizes and shapes of boards.

Factors Influencing Lighting

To light these signboards adequately and economically, certain factors should be taken into consideration. The level of illumination required, for example, depends upon several factors. The brightness of the surrounding area should be taken into account, since the brightness of the board must be higher if it is to compete with bright surroundings. The probable viewing distance must also be considered, for the greater the viewing distance, the higher the illumination level that will be required to attract attention and ensure accurate and easy reading of the board's message.

Another factor is the size of the board in relation to its surroundings. If it is immediately adjacent to large buildings or structures, it will require additional lighting to focus attention upon it. Conversely, if it is relatively large in comparison to its surroundings, the need for a high level of illumination for attention-getting purposes is not as great, and the primary function of the lighting will be for accuracy and ease of reading.

As in any business, the potential market for a product or service must be carefully analyzed before going ahead; and since each signboard in itself is a small selling branch for a particular product or service, it must be determined if its operation will be economically successful. In the case of a signboard, the number of people who daily walk or drive by its location determines the market potential, and the money spent in erecting and lighting the signboard will be determined accordingly.

Lighting Design

Having appraised the factors influencing the lighting requirements, the next step is to determine the location and type of lighting equipment to be employed. In a few cases, the sign may be lighted from remotely mounted equipment. If the sign is at ground level, it may be lighted from some position on the ground in front of it. If the signboard is on the side or top of a building, too high for economical lighting from ground level, the lighting equipment could be placed on a nearby building or behind a building parapet in front of the signboard. In most cases, however, the lighting equipment is mounted on the signboard itself, and this paper will explore the application and economics of this type of mounting.

For many years now the signboard companies have been lighting these signs with incandescent lamps in open type porcelain-enamel reflectors when mounting the units on the board. To increase the amount of illumination, they merely employed a larger lamp or increased the number of units. The current rapid increase in surround brightness resulting from better street lighting, highly illuminated store fronts, and brilliantly lighted shopping centers has necessitated increasing some signboard illumination to near the saturation point in number of units that can physically be hung on it and kilowatt hours of energy that it can economically consume. The next step is to go to a more efficient light source, one that will give more lumens per watt of power consumed. Two such light sources are the fluorescent mercury lamp and the fluorescent lamp.

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 12-16, 1955, Cleveland, Ohio. AUTHOR: Westinghouse Electric Corp., Lighting Division, Cleveland, Ohio.

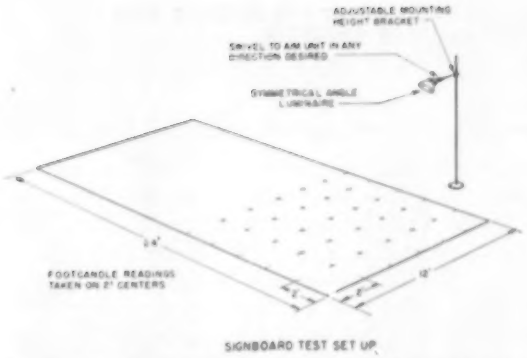
TABLE I — Cost Analysis.

	LIGHTING SYSTEM NUMBER	I	II	III	IV	V	VI	VII	VIII	IX
DESCRIPTION OF LIGHTING SYSTEMS	1. Type of lamp (fil., merc., preheat fluor., dimline, etc.)	Fila. 100W	Fila. 150W	Fila. 200W	Fila. 500W	Fila. 750W	Fluor. Merc. 100W	Fluor. Merc. 175W	Fluor. Merc. 250W	Fluor. Merc. 400W
	2. Lamp description	A-21 I.F.	A-23 I.F.	PS-30 I.F.	PS-40 I.F.	PS-52 I.F.	M-H4	B-H22	D-H5	J-H1
	3. Type of luminaire	Sym Angle 100W	Sym Angle 200W	Sym Angle 300W	Sym Angle 500W	Sym Angle 750W	Sym Angle 500W	Sym Angle 500W	Sym Angle 500W	Sym Angle 750W
	4. Number of lamps per luminaire	1	1	1	1	1	1	1	1	1
BASIC DATA	5. Rated initial lamp lumens per luminaire	1,630	2,650	3,700	9,900	15,600	*2,500	*6,000	11,000	19,000
	6. Lamp life	750	750	750	1,000	1,000	4,000	4,000	6,000	6,000
	7. Watts per luminaire (including auxiliary)	100	150	200	500	750	127	205	292	447
	8. Ratio Avg/Min	3.5	5.2	2.5	4.2	4.4	4.8	5.0	3.7	4.2
	Ratio Max/Min	6.3	9.8	4.4	9.3	10.3	11.0	11.0	9.3	9.8
	9. Maintenance factor	.65	.65	.65	.65	.65	.75	.75	.75	.75
	10. Number of luminaires	3	3	3	2	2	2	2	2	2
	11. Average footcandles maintained (Approx.)	2.5	4.0	6.5	10	26	7.5	11	20	28
	12. Energy rate ($ per KWH)	$0.0275	0.0275	0.0275	0.0275	0.0275	0.0275	0.0275	0.0275	0.0275
	13. Estimated burning hours per year	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
INITIAL COST	14. Net luminaire cost (each)	$ 3.50	4.00	4.00	5.50	8.75	5.50	5.50	5.50	8.75
	15. Net additional accessory cost per luminaire	$ ——	——	——	——	——	**40	**44	**59	**59
	16. Estimated wiring & installation cost per luminaire	$ 8	8	8	9	9	10	10	10	10
	17. Net initial lamp cost each (list less 30%)	$ 0.13	0.16	0.23	0.70	2.14	8.75	11.90	14.35	14.70
	18. Net initial lamp cost per luminaire (4 × 17)	$ 0.13	0.16	0.23	0.70	2.14	8.75	11.90	14.35	14.70
	19. Total initial cost per luminaire (14 + 15 + 16 + 18)	$ 11.63	12.16	12.23	15.20	19.89	64.25	71.40	88.85	92.45
	20. TOTAL INITIAL COST (10 × 19)	$ 35	36	37	30	40	128	143	178	185
FIXED CHGS. ANNUAL	21. Initial cost per luminaire less lamps (14 + 15 + 16)	$ 11.50	12.00	12.00	14.50	17.75	55.50	59.50	74.50	77.75
	22. Total initial cost less lamps (10 × 21)	$ 34.50	36.00	36.00	29.00	35.50	111.00	119.00	149.00	155.50
	23. ANNUAL FIXED CHARGES (15%† of 22)	$ 5.18	5.40	5.40	4.35	5.32	16.65	17.85	22.35	23.32
ANNUAL OPERATING COSTS	24. Annual no. lamp replacements (4 × 10 × 13 ÷ 6)	8	8	8	4	4	1	1	.67	.67
	25. Annual cost of replacement lamps (17 × 24)	$ 1.04	1.28	1.84	2.80	8.56	8.75	11.90	9.60	9.85
	26. Annual cost of replacement parts (starters, etc.)	——	——	——	——	——	——	——	——	——
	27. Total annual maintenance material cost (25 + 26)	$ 1.04	1.28	1.84	2.80	8.56	8.75	11.90	9.60	9.85
	28. Estimated labor cost to replace one lamp	$ 1.50	1.50	1.50	1.50	1.50	1.75	1.75	1.75	1.75
	29. Total labor cost to replace lamps (24 × 28)	$ 12.00	12.00	12.00	6.00	6.00	1.50	1.50	1.17	1.17
	30. Estimated cleaning cost per luminaire	$ 1.00	1.00	1.00	1.00	1.00	1.25	1.25	1.25	1.25
	31. Number of cleanings per year	1	1	1	1	1	1	1	1	1
	32. Annual cleaning cost (10 × 30 × 31)	$ 3.00	3.00	3.00	2.00	2.00	2.50	2.50	2.50	2.50
	33. Total annual maintenance labor cost (29 + 32)	$ 15.00	15.00	15.00	8.00	8.00	4.00	4.00	3.67	3.67
	34. Total Annual Maintenance Cost (27 + 33)	$ 16.04	16.28	16.84	10.80	16.56	12.75	15.90	13.27	13.52
	35. Annual Energy Cost (7 × 10 × 12 × 13 ÷ 1000)	$ 16.50	24.75	33.00	55.00	82.50	13.97	22.55	32.12	49.17
	36. TOTAL ANNUAL OPERATING COST (34 + 35)	$ 32.54	41.03	49.84	65.80	99.06	26.72	38.45	45.39	62.69
Total and REL. COSTS	37. TOTAL ANNUAL COST (23 + 36)	$ 37.72	46.43	55.24	70.15	104.38	43.37	56.30	67.74	86.01
	38. Relative Annual Cost	100%	123%	146%	186%	277%	115%	149%	180%	228%
	39. Annual Cost per Footcandle (37 ÷ 11)	$ 15.09	11.61	8.50	3.69	4.01	5.78	5.12	3.39	3.07
	40. Relative Annual Cost per Footcandle	492%	378%	277%	120%	131%	188%	167%	110%	100%

†Usually 15%, assuming 10-year amortization with 5% allowance for taxes, insurance and interest.
*Estimated.
**Ballast and Lens Assembly.

Testing Procedure

First, let us compare the filament lamp and the fluorescent mercury lamp. In order to make such a comparison, data are required to show the level of illumination provided by various sizes of lamps. One of the most practical units for the lighting of signboards, is the RLM Standard Symmetrical Angle reflector. The luminaire consists of a hood



SIGNBOARD TEST SET UP

Figure 1. Test set-up used to measure illumination on a signboard when various size reflectors and lamps are used.

and detachable reflector. The hood is provided with a water-drip skirt to make the unit weatherproof. The reflector is finished with the highest quality porcelain enamel, conforming to the Standards of the RLM Standards Institute. These data were obtained by marking off an area 25 feet by 12 feet and mounting a luminaire and lamp at a specified distance away from this area. (Fig. 1) The most practical mounting distance of the units away from the board was determined by exploratory tests and by discussion with a large commercial outdoor advertising firm. Obviously the further out from the board the luminaires are mounted, the better the uniformity of illumination that can be obtained. However, as the distance from the board to the luminaire is increased, the expense of mounting the units increases, and the appearance of the board suffers. In discussing this problem with signboard companies who have dealt with it for years, it was determined that the most practical distance from the board to the luminaire was 6½ feet to 7 feet. A 7-foot test distance was, therefore, employed for this analysis. The luminaire was then adjusted to obtain maximum illumination uniformity over the 12-foot height of the board and footcandle readings were made at 2-foot intervals over the entire board. From such data for each test lamp, the average illumination on the board can be determined for any number of luminaires mounted on the board using that lamp. This information was gathered for various incandescent and mercury lamps of different wattages. A cost analysis was then derived using as a base the minimum number of units using each wattage lamp that would be required to obtain satisfactory illumination uniformity across the board.

Economic Analysis

The Cost Analysis is shown in Table I and it should be remembered that the different lamps do not provide the same illumination average. In making a cost analysis, it is always necessary to make certain asumptions, the more important of these assumptions being energy rate, burning hours per year, and amortization period for equipment cost. In this analysis the energy rate selected was $0.0275 per kwh; the burning hours per year estimated at 2000 hours, and an amortization period of 10 years assumed for equipment costs. The accesory cost per luminaire, line 15 on the cost analysis, for the units using the fluorescent mer-

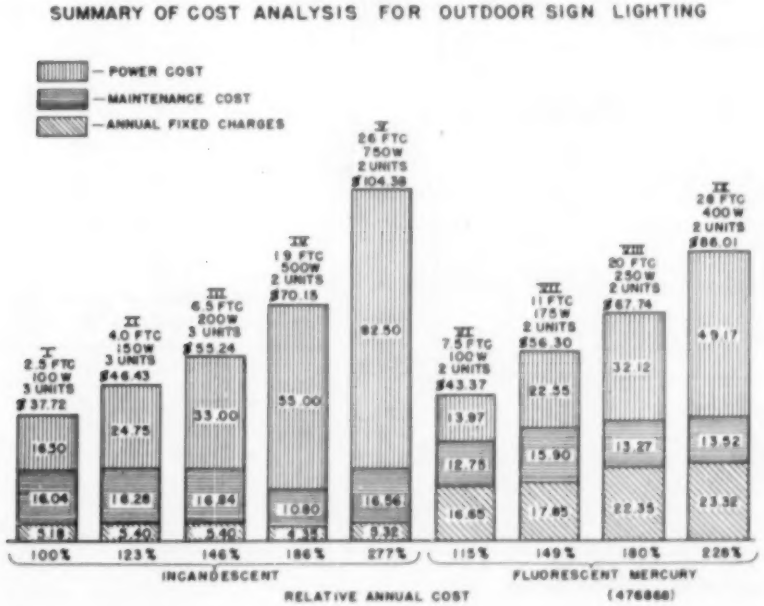

SUMMARY OF COST ANALYSIS FOR OUTDOOR SIGN LIGHTING
— POWER COST
— MAINTENANCE COST
— ANNUAL FIXED CHARGES
X 2.5 FTC 100W 3 UNITS $37.72 16.30 16.04 5.18
XI 4.0 FTC 150W 3 UNITS $46.43 24.75 16.28 5.40
III 6.5 FTC 200W 3 UNITS $55.24 33.00 16.84 5.40
IV 19 FTC 500W 2 UNITS $70.15 55.00 10.80 4.35
V 26 FTC 750W 2 UNITS $104.38 82.50 16.56 5.32
VI 7.5 FTC 100W 2 UNITS $43.37 13.97 12.75 16.65
III 11 FTC 175W 2 UNITS $56.30 22.55 15.90 17.85
VIII 20 FTC 250W 2 UNITS $67.74 32.12 13.27 22.35
IX 26 FTC 400W 2 UNITS $86.01 49.17 13.52 23.32
100% 123% 146% 186% 277% 115% 149% 180% 228%
INCANDESCENT
FLUORESCENT MERCURY (476866)
RELATIVE ANNUAL COST

Figure 2. Cost of lighting analysis — summary of cost analysis for 24-sheet poster board based on relative annual cost.

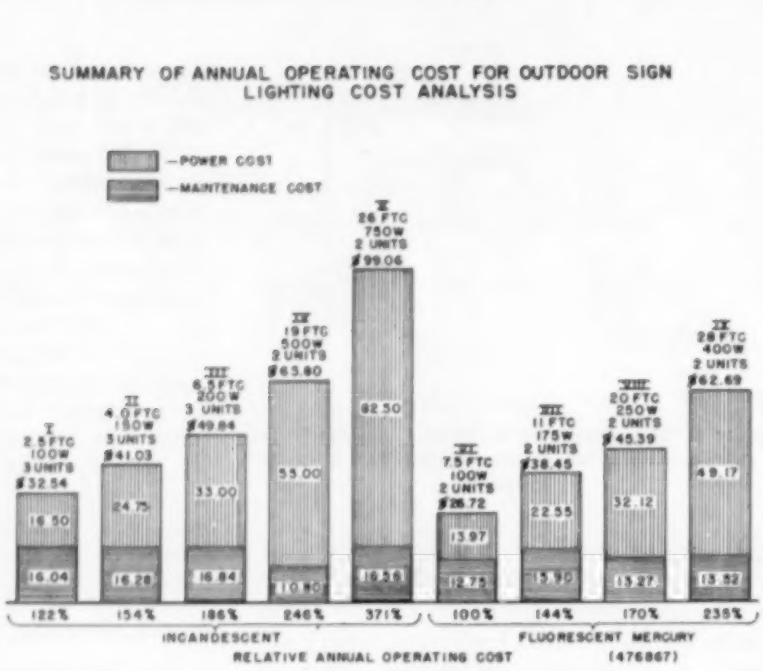


Figure 3. Power and Maintenance cost comparisons for 24-sheet poster board.

cury lamp is made up of ballast cost plus a plain clear cover glass lens assembly cost. This lens assembly is required since the mercury lamps must be protected from the weather. An estimated cost of $10.00 per unit was allowed for this cover glass. The relative annual cost shown in line 38 of the cost analysis would seem to favor the incandescent lamp. However, the relative annual cost per footcandle shown in line 40 definitely shows the fluorescent mercury lamp to be the more economical. Fig. 2 is a bar diagram summary of the cost analysis showing how the total annual cost figure for each lamp is divided between power cost, maintenance cost and annual fixed charges. It is seen rather readily from this chart that the incandescent lamp and its associated equipment is low in initial cost but rather high in upkeep compared to the fluorescent mercury lamp. Fig. 3 is a bar diagram showing a comparison of annual operating costs consisting of power cost and maintenance cost. The maintenance cost seems to hold fairly constant because the advantage of the long mercury lamp life is partially offset by its higher lamp replacement cost. These figures could vary consid-

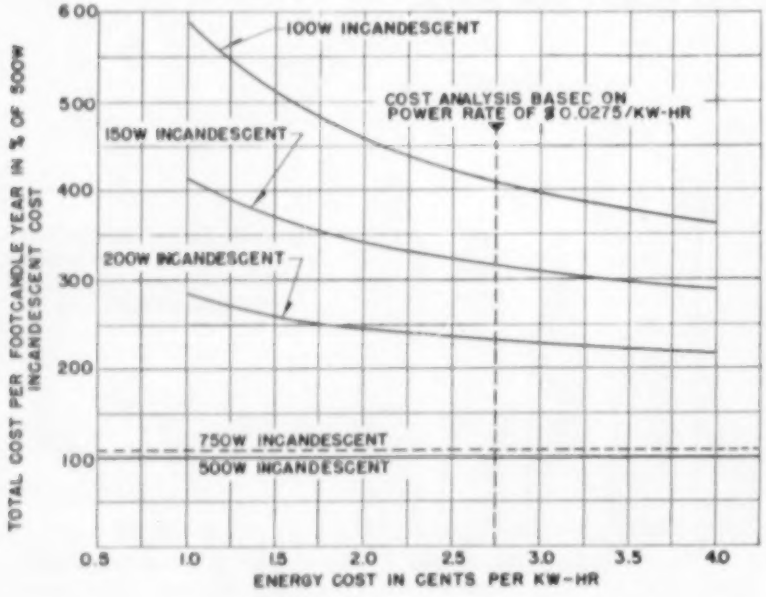


Figure 4. Effect of power cost on total annual cost per footcandle year for incandescent lamps.

erably throughout the country depending upon the labor rates involved in maintenance of the boards.

Effect of Varying the Energy Rate

The one single item that could affect the cost analysis more than anything else would be a difference in the energy rate. From the cost analysis it can be seen that the 500-watt incandescent lamp is the most economical incandescent lamp based on the relative annual cost per footcandle. To find what effect a change in energy rate would cause, a curve was plotted of total cost per footcandle year in per cent of 500-watt incandescent cost *vs* energy cost in cents per kilowatt hour. Fig. 4 shows the effect of energy rate on the various sizes of incandescent lamps, and Fig. 5 shows the effect of energy rate on the various sizes of mercury lamps in per cent of the 500-watt incandescent lamp costs. From Fig. 4, it can be seen that all of the low wattage incandescent lamps are much more costly at all energy rates than the 500-watt lamp, while the 750-watt lamp stays at a fixed percentage above the 500-watt lamp. From Fig. 5 it can be seen that at the lower energy rates the 500-watt incandescent lamp is less expensive, but as the energy rate incerases the advantage goes to the fluorescent mercury lamp. The low wattage mercury lamps remain above the 100 per cent line of the 500-watt incandescent lamp, but they in turn are far below the low wattage incandescent lamps. Figs. 6 and 7 show how change in energy cost would affect annual operating cost per footcandle year in per cent of 500-watt incandescent cost. Fig. 6 compares the low wattage incandescent lamps against the 500-watt lamp, and they again are shown to be far more expensive. Fig. 7 shows the 250-watt and 400-watt fluorescent mercury lamps to be considerably less expensive to operate and maintain, and even the 100- and 175-watt fluorescent mercury lamps become lower in operating cost at the higher energy rates.

From Table II it can be seen that by going from incandescent lighting to fluorescent mercury lighting and keeping the installed wattage approximately the same, the maintained illumination level may be more than doubled.

TABLE II — Energy Requirements and Illumination Values for a Signboard Using Various Incandescent and Fluorescent Mercury Lamps.

Lamp	Number of Units per Board	Average Maintained Footcandles	Total Load per Board in Watts (Including Auxiliaries)*
100W A-21 I.F.	3	2.5	300
150W A-23 I.F.	3	4.0	450
200W PS-30 I.F.	3	6.5	600
500W PS-40 I.F.	2	19	1000
750W PS-52 I.F.	2	26	1500
100W ** M-H4	2	7.5	254
175W ** B-H22	2	11	410
250W ** D-H5	2	20	584
400W ** J-H1	2	28	894

*Ballast Loss for Mercury Lamps.
**Fluorescent Mercury Lamps.

Fluorescent Lighting

It is unfortunate that time did not permit the inclusion of a fluorescent lamp unit in the cost analysis study. Certain advantages and disadvantages of such a unit are readily apparent without extensive tests being run. The 100-watt 72-inch T-12 rapid start fluorescent lamp would be well

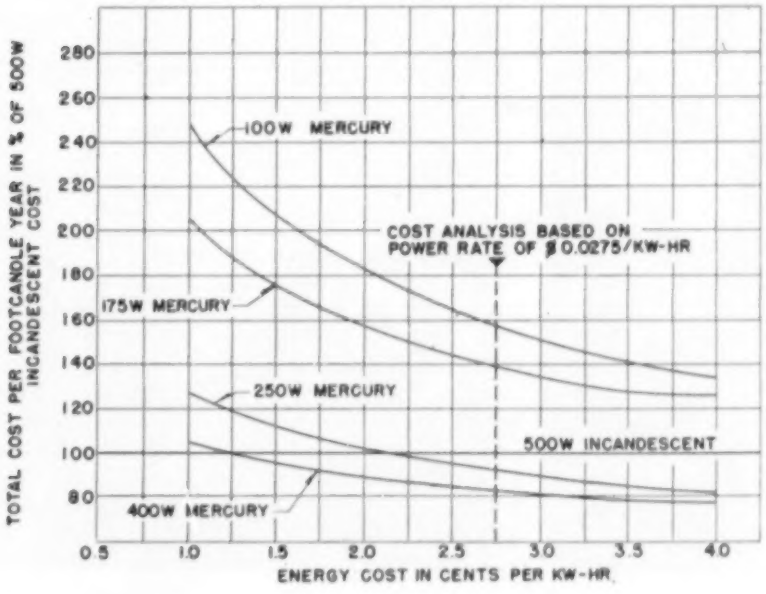


Figure 5. Effect of power cost on total annual cost per footcandle year for mercury lamps vs. 500-watt incandescent.

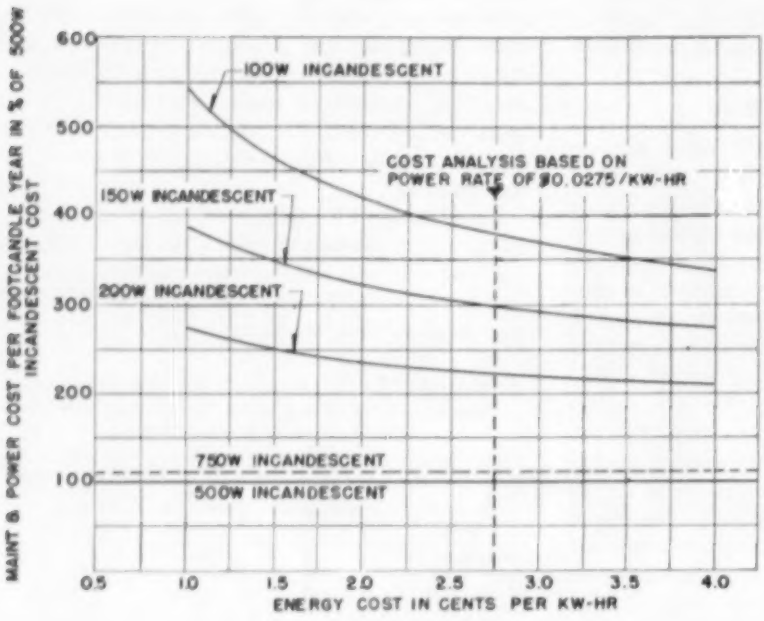


Figure 6. Effect of power cost on annual operating cost per footcandle year for incandescent lamps.

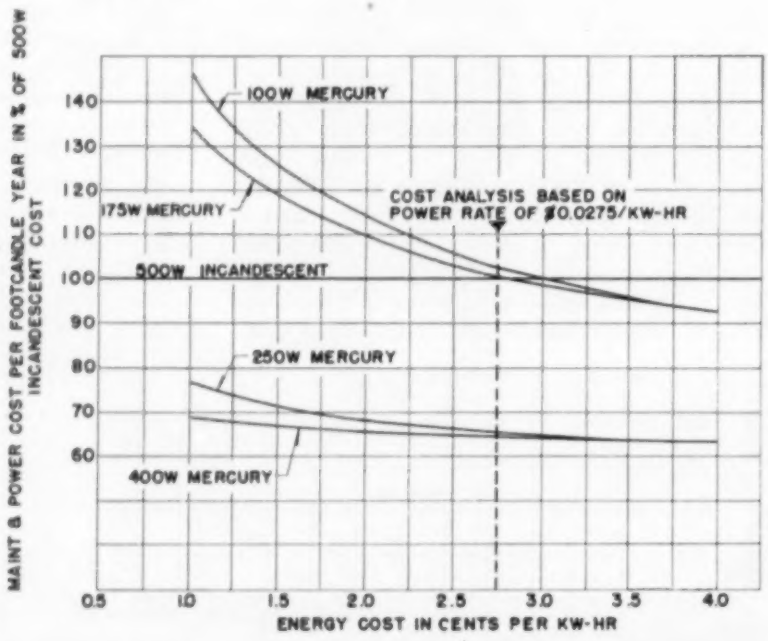


Figure 7. Effect of power cost on annual operating cost per footcandle year for mercury lamps vs. 500-watt incandescent.

suited for an application such as this. The variation in light output as a function of temperature would not be a major factor since this lamp has already proven itself in the fluorescent street light. It is a highly efficient light source with long life. However, at the present time it would seem that any luminaire designed to use this lamp would be inherently expensive. The size of the housing and the need to make it weather-proof would place its initial cost far above that of a simple angle reflector. It would make up some of this difference in lower power and maintenance costs per footcandle of illumination on the board. Its greatest advantage would lie in its possibility of being an integral part of the signboard. The filament and fluorescent mercury lamp of necessity must be hung out from the top of a sign like so many fishpoles off a bridge on a sunny afternoon. The fluorescent unit could be built into the sign itself extending no more than two or three feet out from the top of

the board, and of such simple straight line simplicity as to change the ugly duckling of the highway and vacant lot into a Cinderella of the advertising industry.

Conclusion

To meet the requirement of higher illumination levels for signboards today, the fluorescent mercury lamp seems to be the immediate answer. The higher efficiency and longer life of this light source make it possible to raise the level of illumination on the signboard, while at the same time keeping maintenance costs and energy consumption at a minimum. This can be accomplished by using the basic luminaire and mounting arrangement now used with incandescent lamps. There remains a great deal of work to be done, however. Tests should be conducted on various luminaire and lamp combinations in order to decrease the distance the luminaire must be mounted from the board and to increase the area covered by one luminaire. Of prime consideration should be the development and testing of a fluorescent unit for signboard lighting.

Two Ways to Dress a Living-Room

FOR CHRISTMAS

Mantelpiece Angels. **A plywood frame, 3½ inches deep at the bottom and 3¼ inches deep on sides and top, forms a temporary panel as a base for Christmas decoration. The panel is painted a soft green to match the room walls and angel hair is draped to frame the setting. Recessed behind the frame are five small intermediate base lamps mounted on a wooden strip 52 inches long. At the top of the frame, mounted to the inner side of a dropped down valance is a similar strip of ivory colored lamps. Dolls are dressed in yellow, blue, gold and pink. Extension cord connects fixtures to a convenience outlet at the right side of the fireplace.**

Christmas Niche. **A window, facing a brick wall, is blocked off and used as a lighted niche, 38 inches high by 42 inches wide. Three fluorescent channels are mounted in the sides and top of the frame — two 15-watt 3500-degree white at the sides and one 14-watt daylight at the top. A frosted glass panel is fitted over these, forming the frame. The blue and gold Madonna is made of paper and pasted to the mirrored background. The organ pipes are gold-colored and the choir boys are dressed in red and white.**

Photographs and data courtesy of Miss Mary Taepke, Detroit Edison Co., Detroit, Mich.

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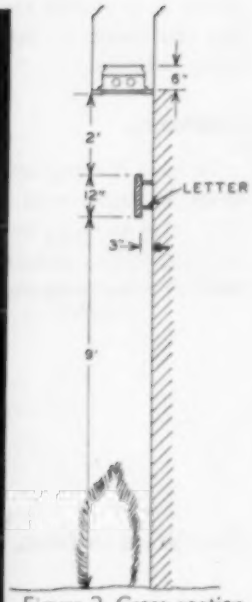

Figure 2. Cross-section of installation.

INSTALLATION AT LIBERTY ADVERTISING CO., 34 SOUTH MACDADE BLVD., GLENOLDEN, PA.

Lighting a Building Identification Sign

LIGHTING OBJECTIVE: To provide a lighting system for the silhouette illumination of a "face" sign, pleasing architectural feeling and attractive brightness of the surroundings.

GENERAL INFORMATION: The silhouette block letter sign is mounted on an exterior red brick wall (15% RF) of a building which houses a firm of creative advertising specialists. The stainless steel letters (55% to 65% RF) are 12 inches high and 2 inches deep with a 1-inch stroke.

INSTALLATION: Six Quaker City catalog No. RG-2488 troffers, each using two 40-watt T-12 standard cool white rapid-start fluorescent lamps, are recessed in the building soffit over the sign as shown in Fig. 2. The resultant vertical illumination on the building face is: level of letters, 25 ft-c; six feet above ground, 15 ft-c; three feet above ground, 8 ft-c.

Average background brightness is 4 footlamberts. Visibility distance is 300 feet.

Lighting designed by Edwyn G. Rorke, architect, 5 East Airy St., Norristown, Pa.; sign designed and supplied by the Modern Sign Advertising Co., 2800 North Hancock St., Philadelphia, Pa.; builder: Max Essl, 341 Michigan Ave., Swarthmore, Pa.; electrical contractor: Raymond M. Featherer, 89 East Stratford Ave., Lansdowne, Pa.

Lighting data submitted jointly by E. F. Kingsmore and George T. Anderson, Jr., Lighting Engineers, Philadelphia Electric Co., 1015 Chestnut St., Philadelphia, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

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DATA FOR

Designing Show Window General Lighting With Par and R Lamps

By CHARLES N. CLARK

SHOW WINDOWS occupy the most valuable and strategically located space in the majority of stores. It has been shown[1,2] that the advertising value of show window displays can be multiplied by effective lighting. Modern lamps and lighting equipment have made it practical and economical to create windows that successfully compete with the high-brightness distractions outside the window in the daytime. They also are an important means of overcoming veiling reflections in the window glass that so often occur during the daytime hours, when the selling impressions of the window are most valuable to the merchant.

Footcandle Requirements

Studies have shown[3,4] that 200 footcandles on medium-reflectance merchandise is generally adequate for seeing through reflections of sunlit buildings, pavement, and street traffic. Observations and relative ratings of a series of windows indicate that several times this illumination (spotlighting of the order of 1000-2000 footcandles) is needed for definitely attracting attention to featured parts of displays, under the above conditions. These higher levels are also needed for more visibility of dark merchandise. Experience has shown that 200 footcandles of general lighting is desirable as a basic part of the system for a wide variety of conditions, although many windows may require individual study. Similar lighting levels are often required at night, particularly where there is strong competition from signs, street luminaires, nearby show windows, etc.

Lighting Methods

Incandescent lamps are virtually a necessity for achieving general lighting levels of the order of 200 footcandles in most windows, because of their ability to provide a great amount of light from the relatively small ceiling area available at the top front of the window. In many cases, fluorescent lamps are also a desirable part of the general lighting system, because of their high efficiency and low heat radiation per footcandle, the long, low-brightness highlights they create, and the variety of colors available. But their inherently low brightness limits the amount of light that can be delivered from the ceiling, especially since the rows of lamps toward the rear of the window contribute relatively little vertical illumination.

Show window lighting units of mirrored glass, prismatic glass, or metal, with asymmetric light distribution tailored for various window proportions, have been widely used for general lighting. They continue to be an effective and economical system.

Another system borrows from stage lighting techniques, utilizing theatrical border strips or fresnel-lens spotlights adjusted for a broad beam, to supply general lighting.

In recent years, there has been increasing use of reflectorized lamps for general as well as spotlighting in show windows. Their simplicity of installation, ease of maintenance, and compactness, together with the wide variety of beam shapes and wattages available, no doubt account for the growth of their use.

Design Data Requirements

Available data[5] enable the engineer to design for any footcandle level of general lighting, using asymmetric filament-lamp show window reflectors or fluorescent units. The data herein presented enable one to make similar design calculations for reflectorized lamps. For simplicity of calculation, they assume that the required lighting level is 200 footcandles, although provision is made for other levels.

It was felt that the design data for PAR and R lamps should be related as closely as possible to the existing data for asymmetric reflectors, both because of the general understanding and acceptance of that data, and because comparisons between various lighting systems would thus be simplified. Therefore, it was decided to present the data in terms of illumination in the three display

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 12-16, 1955, Cleveland, Ohio. AUTHOR: Application Engineering, Large Lamp Dept., General Electric Co., Nela Park, Cleveland, Ohio.

zones used in the existing design tables[5] (see Fig. 7), and to use H/D as the index of window proportions.

The factors to be accounted for in any method of lighting design with PAR and R lamps are: size and proportions of window, reflectances of interior, lamp output, beam distribution, maintenance factor, center-to-center lamp spacing, lamp aiming angle, and, finally, illumination in the display zones. All these factors, except lamp aiming angle, are involved in the tables for asymmetric units.[5] The inclusion of aiming angle as a variable in the design procedure gives desirable flexibility in planning the lighting system. It also results in more expansive and complete (though not necessarily more complicated) design tables.

Test Window

The relationship among the variables is such as to preclude getting reliable design data by any method other than experimental. Accordingly, a full-scale test window was constructed (see Fig. 1). It was built of metal framing, and so arranged that the back surface of the window could be moved back and forth. The ceiling, back, and one side were covered with 60 per cent reflectance gray cardboard. The front and one side were covered with transparent plastic sheets, to simulate the reflecting characteristics of glass.

Dimensions were: width — 12 feet; height to ceiling — nine feet; height to light center — 8⅓ feet; depth — variable from two to nine feet. Across the top front was a channel with provision for mounting lamps on one-foot centers. This channel could be rotated about its longitudinal axis to permit aiming the lamps in any direction from straight down to horizontally into the window.

Figure 1. The test window, with photocells in position for reading zone C illumination. Clear plastic sheets simulating glass are on front and right side. Large panels in center are for observing distribution and uniformity of illumination within display zones. Lamps are 300-watt PAR-56 medium flood in supporting housings.

Three cell pads with footcandle-microammeters were used to read illumination. The cells were mounted on strips positioned so that the cell faces were in the planes of the respective display zones *A*, *B* and *C* (Fig. 7). The cell mounting strips were on rollers, and by means of a system of ropes and pulleys could be made to traverse the width of the window for readings at as many lateral positions (6 to 12) as required for accurate determination of average illumination. The cells were positioned on the centerlines of the upper, middle and lower thirds respectively of each display zone.

As noted in Table I, five different lamp types were tested. The lamps were carefully selected to have typical candlepower distributions.

Test Procedure

The following discussion, based on PAR-38 floodlamps, illustrates the type of data obtained, and how it was reduced to design tables. There were variations for other lamp types — notably the spot-distribution lamps, for which footcandle readings were taken at closer lateral spacings and for more aiming angles.

PAR-38 floodlamps were mounted at the top front of the window on one-foot centers. The back was set at a distance of five feet (corresponding to $H/D = 1.67$) from the "glass." The three cells were mounted in the *A*-zone. With the lamps aimed straight down (0-degree aiming angle), footcandle readings were taken at each of six evenly spaced lateral positions, for a total of 18 readings. The average of these is the average illumination in zone *A*. The lamps were then tilted 15 degrees, and average illumination was again measured in zone *A*. The process was repeated for aiming angles of 30 degrees and 45 degrees. The cells were then positioned in zone *B*, and average zone *B* illumination measured at 0, 15, 30 and 45-degree aiming angles. Finally, the procedure was repeated for zone *C*. Results are plotted in Fig. 2.

Similar curves were obtained for window depths of two feet, three feet and nine feet, corresponding to H/D ratios of 4.16, 2.77 and 0.93 respectively. Since in the final design tables values of display-zone illumination are required at integral values of H/D, the data from the sets of curves similar to Fig. 2 were replotted in the form shown in Figs. 3, 4 and 5. From these families of curves for each lamp type can be read zone illumination for lamps at any aiming angle in windows of any proportion, within the limits of the data. The footcandle values

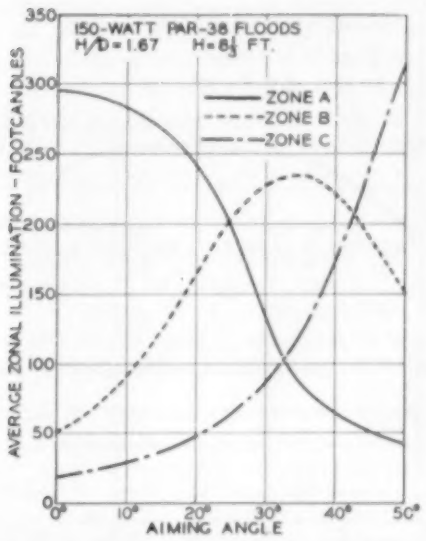


Figure 2. Measured illumination in the three display zones of the test window plotted as a function of lamp aiming angle, for the conditions noted.

appearing there are for lamps on one-foot centers in a window of specific height (8⅓ feet). In order to put the data in design tables, they must be set up in a form applicable to windows of varying size and proportions, with allowance for selecting appropriate lamp spacing and aiming angle.

Method of Presenting Data

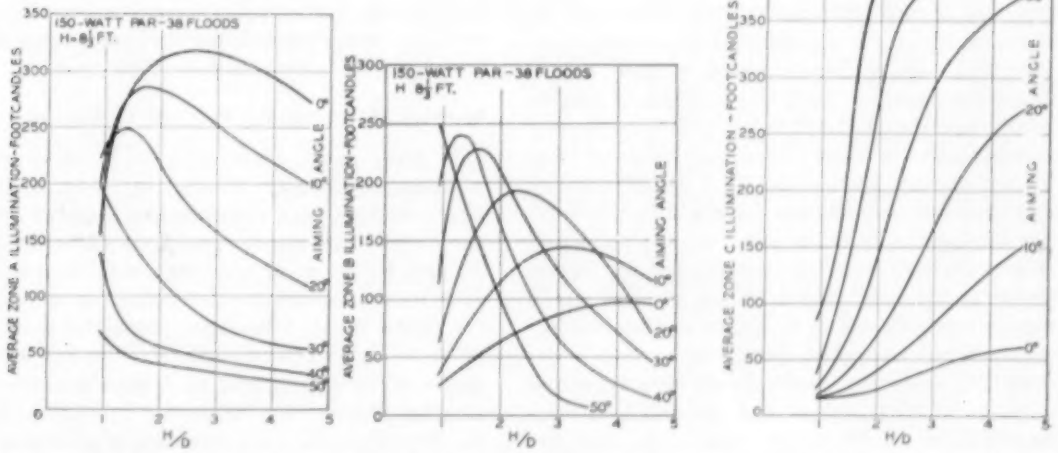
In general, the user of the design data will start with a window of fixed dimensions. He will be interested in selecting the apropriate lamp type, spacing and aiming angle to deliver a desired footcandle level in a specific zone or zones. Several methods of presenting the design data to accomplish these aims were investigated. The system described below was selected as being the simplest and most practical.

The basic design data are given in Table I. The illumination factors (F_A, F_B, F_C) given there were obtained by multiplying the footcandle values from Figs. 3, 4 and 5 and other similar curves by a factor of 0.4, the derivation of which is given in Appendix A. Any particular illumination factor, when divided by window height in feet, will yield lamp spacing in inches that produces an average maintained illumination of 200 footcandles in zone *A*, *B* or *C* (depending on whether F_A, F_B or F_C was used).

For a given lamp spacing in a window of fixed dimensions, the factors F_A, F_B and F_C are in direct proportion to the illumination produced in the respective zones by the various lamp types at the indicated angles. Thus, the variation in illumination among zones can readily be predicted.

In most applications, maximum illumination is desired in zone *A* or zone *B*, or both, in order to avoid excessive brightness on the upper parts of typical displays and backgrounds. Use of the tabular data in bold type will lead to the selection of lamp types and aiming angles that provide nearly equal illumination in zones *A* and *B*. Illumination in zone *C* will be the same or lower.

The boldface figures in the table appear only for



Figures 3, 4 and 5. Illumination in zones A, B and C, respectively, of the test window, plotted as a function of H/D, for various lamp aiming angles.

those lamp types and aiming angles for which the following conditions are satisfied:

1. $F_A > \frac{1}{2} F_{A\,max.}$ The maximum values refer to
2. $F_B > \frac{2}{3} F_{B\,max.}$ the highest value for any given
3. $F_B > F_C > \frac{1}{2} F_B$ lamp type and value of H/D.

These conditions insure that illumination in zones A and B will be of the same order, that there will not be excessive variation of brightness among zones or vertically within a zone, and that zone C will not be exceedingly bright nor very dark compared to the other two.

Lateral Uniformity

Visual observations were made to check lateral uniformity (absence of streaks and scallops due to proximity of lamps to background). For each lamp type, it was found that the window depth at which just-noticeable lateral non-uniformity was evident near the top of the background was largely independent of lamp aiming angle. Thus it was possible to determine the uniformity factors that appear at the bottom of Table I. The factor for each lamp type is simply the ratio of the test lamp spacing (12 inches) to the window depth (feet) at which threshold non-uniformity was observed.

Effect of Window Length

Since the test data were taken on a window of fixed height and length ($L/H = 1.5$) the results will apply rigorously only to the windows with similar L/H ratio. To determine the effect of variations in window length on average display-zone illumination, the three-cell average-footcandle readings in each zone were plotted as a function of distance from one side of the window. This was done for each lamp type at four different H/D ratios. In each case, the aiming angle was one that might typically be used in practice. One such curve is shown in Fig. 6. It was assumed that increased or decreased window length would increase or decrease the length of the Y-section of the curves, in which the illumination values are substantially constant. The average illumination values for the 12-foot window include the X, Y and Z sections. For an 8-foot-long window ($L/H = 1.0$), the average illumination would be based on only the X and Z sections, and would be lower, since the curves droop at the ends. For a 16-foot window, the Y section would be double in length, and the average values would be higher. Using this method it was found, by averaging results for all lamp types and a range of H/D values, that for windows with length equal to or greater than height, average illumination as determined from Table I will be precise within five per cent. For windows with length equal to ½ height, it appears that illumination factors must be decreased about 15 per cent.

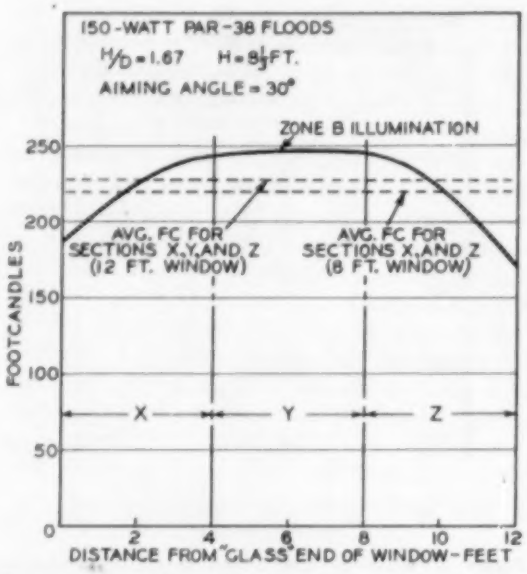


Figure 6. Variation of vertically-averaged zone B illumination across the width of the test window, for the conditions noted.

Effect of Interior-Finish Reflectance

To determine the effect of dark interior finishes or of an open back window, tests were conducted with black cardboard on the back, ceiling and side wall of the test window. R-40 floods and PAR-38 spots were used in deep ($H/D = 0.93$) and shallow ($H/D = 4.16$) windows. With the black surfaces, average illumination was 10-15 per cent lower for the floodlamps, and 5-10 per cent lower for the spotlamps, than with the 60 per cent R.F. surfaces. Thus it may be stated that for open-back windows, or those with dark interior finishes, illumination factors should be reduced 5 to 15 per cent.

Method of Increasing Vertical Uniformity

In many cases, particularly in relatively deep windows, uniformity among the zones may be improved by aiming alternate lamps at two different angles. Appropriate angles are those at which F_A and F_B are at or near their maximum values. Illumination factors are determined by averaging the factors for the two angles. Example: for PAR-38 floods in a window with $H/D = 1.5$, aiming angles of 10 degrees and 40 degrees are selected. Average illumination factors are $F_A = 72.5$, $F_B = 65$, $F_C = 32.5$. The same technique of averaging the illumination factors applies where two different lamp types are used, at either the same or different

aiming angles. The italicized factors in Table I indicate pairs of aiming angles that will give acceptably uniform results for a single lamp type, and appear only for those lamp types and aiming angles for which the averaged illumination factors meet the criteria discussed above under "Method of Presenting Data."

Acknowledgment

The author gratefully acknowledges the advice and assistance of his colleagues, Messrs. R. T. Dorsey, W. S. Fisher, Jr., J. A. Frederickson, Keith Bower and David Lewis, in obtaining the test data and in the preparation of this paper.

Appendix A — Derivation of Illumination Factors

For a given lamp type, aiming angle, and window proportion (H/D), the average illumination in any zone is directly proportional to maintenance factor and inversely proportional to window height (H) and lamp spacing (S). This can be shown informally by considering the basic formula for illumination:

$$\text{Illumination} = \frac{\text{lumens}}{\text{area}} \times \text{C.U.} \times \text{M.F.}$$

But lumens = no. of lamps × lumens/lamp

$$\text{and no. of lamps} = \frac{\text{length of show window}}{\text{lamp spacing}} = \frac{L}{S}$$

so lumens = $L/S \times$ lumens/lamp

Also, area = length × width = $L \times$ width.

But the width of one of the zones in a show window with a given H/D ratio is proportional to the window height,

or, width = a constant × H

so area = $L \times H \times$ a constant.

Substituting in the original expression:

$$\text{Illumination} = \frac{L/S \times \text{lumens/lamp}}{L \times H \times \text{a constant}} \times \text{C.U.} \times \text{M.F.}$$

$$= \left[\frac{\text{lumens/lamp}}{\text{a constant}} \times \text{C.U.}\right] \times \frac{\text{M.F.}}{H \times S}$$

Since the quantity in brackets is made up of items with constant values for a given lamp type, aiming angle, and H/D ratio, the equation may be rewritten:

$$(1) \qquad E = \frac{K \times MF}{H \times S}$$

where: E is average illumination in any zone.
K is a constant involving window proportions and finishes, lamp output, and light distribution.
MF is maintenance factor.

If E and MF are given fixed values, then:

$$(2) \qquad E_f = \frac{K \times MF_f}{H \times S}$$

where: E_f is a fixed value of zonal illumination.
MF_f is an assumed maintenance factor.

So that:

$$(3) \qquad S = \frac{K \times MF_f}{E_f \times H} = \frac{F}{H}$$

where: $$F = \frac{K \times MF_f}{E_f} = \text{a constant}$$

That is, lamp spacing that will produce the fixed value of display-zone illumination is given by a constant divided by window height. (Although this assumes a window of infinite length, it holds true within five per cent for windows with $L/H \geq 1.0$, as pointed out in the main text.) The constant F is called "illumination factor" and can be evaluated as follows:

First substitute specific test values in Eq. (1):

$$(4) \qquad E_{test} = \frac{K \times MF_{test}}{H_{test} \times S_{test}}$$

Then divide Eq. (4) by Eq. (2):

$$(5) \qquad \frac{E_{test}}{E_f} = \frac{K}{K} \times \frac{MF_{test}}{MF_f} \times \frac{H}{H_{test}} \times \frac{S}{S_{test}}.$$

So that:

$$(6) \qquad S = \left[\frac{S_{test} \times H_{test} \times MF_f}{MF_{test} \times E_f} \times E_{test}\right] \times \frac{1}{H}$$

Comparing Eq. (6) with Eq. (3), it is seen that the quantity in brackets above is F, illumination factor.

As discussed in the text, a general illumination of about 200 footcandles has been determined effective in competing with daytime reflections under many typical conditions. Accordingly, a value of 200 footcandles zonal illumination was assumed for setting up the tables. Also assumed was a maintenance factor of 80 per cent.

If assumed and test values are inserted in the expression for F from Eq. (6), it is found that:

$$(7) \qquad F = \frac{12 \text{ (inches)} \times 8\tfrac{1}{2} \text{ (feet)} \times .80}{1.0 \times 200 \text{ (fc)}} \times E_{test} \text{ (fc)}$$

$$= 0.4\, E_{test} \text{ (ft.-in.)}.$$

F is given the subscript A, B or C, depending on the zone in which the illumination E_{test} was measured.

References

1. Sturrock, W., and Schute, J. M.: "Effect of Light on the Drawing Power of the Show Window," *Transactions I.E.S.*, Vol. XVII, No. 10, pp. 683-694 (December 1922).

2. *Sales Lighting Tests in Ten Stores*, A joint report by the Ohio Public Service Co., the Cleveland Electric Illuminating Co., and Lamp Division, General Electric Co. (1936).

3. Harrison, W., and Sturrock, W.: "Daytime Illumination in Show Windows," *Transactions I.E.S.*, Vol. XX, No. 2, pp. 135-145 (February 1925).

4. Harrison, W., and Spaulding, H. T.: "Overcoming Daylight Reflections in Show Windows," *Transactions I.E.S.*, Vol. XVII, No. 10, pp. 677-682 (December 1922).

5. *IES Lighting Handbook*, Second Edition, pp. 9-29 to 9-33 (1952).

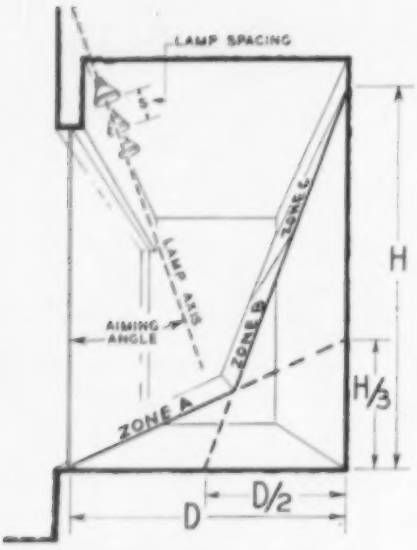


Figure 7. End view, in perspective, of a show window, showing variable dimensions and position of display zones A, B and C. These represent planes of typical window trims, and provide reference locations for illumination measurements. Zones B and C are equal divisions of the upper plane.

STEPS IN DESIGN (See Fig. 7)

1. Determine window height in feet from floor to lamps *(H)*, and window depth in feet from glass to background *(D)*. The ratio of these items (H/D) provides an index of window proportions for use in the first column of Table I.

EXAMPLES:

1. Window height = 9 feet, window depth = 6 feet. Height/Depth = $H/D = 9/6 = 1.5$

2. Find the most suitable lamp type and aiming angle by referring to Table I and finding the illumination factors in bold type appearing opposite the proper value of *H/D*. Suitable lamp types are indicated by the column in which the bold numbers appear, and suitable aiming angles are indicated by the angle opposite which the bold numbers appear.

If more than one suitable lamp type or aiming angle is found in this manner, then select either the one that produces the desired degree of emphasis in the most important zone, or provides greatest uniformity among zones. Relative illumination in the three zones will be in proportion to the illumination factors (F_A, F_B and F_C) for the zones.

2. In a window with height = 8 ft and depth = 4 ft, $H/D = 2.0$. Illumination factors appear in heavy type opposite $H/D = 2.0$ in the PAR-38 flood column at an aiming angle of 25 degrees, and in the R-40 flood column at 15, 20 and 25 degrees. Either of these lamp types might be used, depending on whether maximum uniformity or greater emphasis in a particular zone is desired. Illumination factors for the PAR-38 flood at 25 degrees are $F_A = 65$, $F_B = 80$, $F_C = 40$. This indicates that average illumination in zone *C* will be 50 per cent of that in zone *B*; and in zone *A*, about 80 per cent of that in zone *B*. Therefore, zone *B* will receive greatest illumination. For the R-40 flood at 25 degrees, the illumination factors for all three zones are equal, indicating that average illumination will be the same in all three zones. At 15 and 20 degrees, the R-40 flood gives greatest emphasis to zone *A*.

3. Find the center-to-center spacing in inches *(S)* that will produce an average of 200 footcandles maintained in the zone considered most important (usually zone *A* or zone *B*). The formula is: $S = F/H$, where F is either F_A or F_B from Table I for the selected lamp type and aiming angle, and H is window height in feet.

3. If PAR-38 floods are selected in order to emphasize zone *B*, lamp spacing for 200 footcandles in zone *B* would be: $S = F_B/H = 80/8$ ft = 10 inches center-to-center. If R-40 floods were selected for equal zonal emphasis: $S = F/H = 50/8 = 6.25$ inches center-to-center. Total lamp wattage is lower in the first case, but uniformity and overall average illumination are greater in the second.

4. Check to be sure that lamp spacing *(S)* does not exceed S_U, the maximum spacing in inches for generally satisfactory lateral uniformity (absence of streaks and scallops) in all zones. $S_U = U \times D$, where U is the uniformity factor from the bottom of Table I for the lamp type used, and D is window depth in feet. Unless S_U is radically exceeded, the effect may not be objectionable, because the streaks or scallops would be at the top of the background in a closed-back window, and would probably be unnoticed in an open-back one. If S radically exceeds S_U, closer lamp spacing or a lamp type with a higher uniformity factor should be used.

4. For PAR-38 floods, the uniformity factor from the table is 6. Thus in a window 4 feet deep: $S_U = U \times D = 6 \times 4 = 24$ inches. Since the calculated spacing for 200 footcandles in zone *B* is only 10 inches, good uniformity will be expected. On the other hand, if R-40 spots were to be used in a window 3 feet deep, the maximum lamp spacing for acceptable lateral uniformity would be: $S_U = U \times D = 2 \times 3 = 6$ inches.

TABLE I — Illumination Factors† for PAR and R Lamps.

H/D	AIMING ANGLE (degrees from vertical)	150-WATT PAR-38 SPOT			150-WATT R-40 SPOT*			200-W. PAR-46 MED. FL.** (wide section of beam perpendicular to glass)			150-WATT PAR-38 FLOOD			150-WATT R-40 FLOOD*		
		F_A	F_B	F_C	F_A	F_B	F_C	F_A	F_B	F_C	F_A	F_B	F_C	F_A	F_B	F_C
1.0	0	55	10	5	55	15	5	80	10	5	75	10	5	50	20	5
	10	100	15	5	75	20	10	110	10	5	85	15	10	55	25	5
	20	125	20	5	85	25	10	115	15	5	90	30	10	60	35	10
	30	90	40	10	65	45	15	90	65	10	75	55	10	50	45	20
	35	70	70	15	55	60	20	70	85	10	65	70	15	45	50	35
	40	50	105	15	45	80	20	45	100	15	50	85	20	40	55	30
	45	30	125	20	30	90	25	30	115	30	35	90	30	35	60	35
	50	20	135	25	20	90	30	20	130	25	25	95	40	30	55	40
	55	15	130	35	10	90	40	15	125	45	20	90	50	30	50	45
1.5	0	75	15	5	80	20	10	120	15	15	115	30	10	70	35	10
	10	135	25	5	*100*	*30*	*15*	*140*	*20*	*15*	*115*	*35*	*10*	65	40	15
	20	130	50	10	90	45	20	105	55	30	100	60	15	60	50	25
	25	85	90	15	65	70	25	75	90	20	80	80	20	55	55	30
	30	50	130	20	50	90	30	60	115	25	60	90	30	50	55	40
	35	40	140	30	35	95	40	35	125	35	40	100	40	40	55	50
	40	30	125	45	*30*	*90*	*50*	*55*	*115*	*50*	*30*	*95*	*55*	35	55	60
	45	25	100	60	25	80	65	20	95	70	25	85	75	30	55	70
2.0	0	125	20	5	100	25	10	140	15	20	125	25	10	70	35	15
	10	150	40	10	110	40	15	140	40	20	115	45	15	65	40	25
	15	145	60	15	*95*	*50*	*20*	*120*	*60*	*25*	*100*	*60*	*20*	60	45	30
	20	100	90	25	80	70	30	85	75	30	85	75	30	60	45	40
	25	60	120	35	50	80	40	45	90	40	65	80	40	50	50	50
	30	40	125	45	*40*	*55*	*55*	*55*	*100*	*55*	*45*	*80*	*55*	45	50	65
	35	30	100	60	30	70	75	20	105	70	30	75	85	40	45	80
	40	25	60	85				20	90	95						
2.5	0	185	20	10	120	25	20	150	20	25	125	30	15	70	35	35
	5	175	30	10	115	35	20	145	30	25	120	40	15	70	40	30
	10	155	50	15	*100*	*45*	*25*	*125*	*60*	*30*	110	55	20	65	40	35
	15	120	80	25	80	60	35	90	75	40	95	65	30	60	45	45
	20	70	105	35	55	80	45	50	80	50	70	75	45	55	45	55
	25	40	110	50	*40*	*75*	*65*	*30*	*80*	*65*	*50*	*70*	*65*	45	40	70
	30	30	90	75	35	60	85	20	70	85	35	65	90	40	40	85
3.0	0	185	20	15	130	25	25	155	25	30	125	35	20	65	35	30
	5	*170*	*30*	*20*	115	35	30	140	40	30	115	45	25	65	40	35
	10	145	60	25	*95*	*50*	*35*	115	60	40	100	55	35	60	40	45
	15	100	85	35	70	65	45	80	75	55	85	65	50	55	40	55
	20	*60*	*105*	*50*	*45*	*70*	*60*	40	80	70	60	70	65	50	40	70
	25	30	95	75	35	60	85	25	65	90	40	65	90	45	35	85
3.5	0	180	25	20	130	25	25	160	40	30	125	40	20	65	30	35
	5	*170*	*40*	*25*	110	35	30	140	50	40	110	50	30	60	35	45
	10	135	65	30	85	50	40	105	65	50	95	55	40	60	35	55
	15	75	85	40	60	65	55	65	75	70	75	60	60	55	35	70
	20	*45*	*55*	*65*	40	60	75	35	70	95	55	60	85	45	35	85
4.0	0	175	25	20	125	25	20	155	35	30	120	40	25	60	30	40
	5	*160*	*35*	*25*	105	35	35	130	55	45	105	50	35	60	35	50
	10	120	65	35	70	50	45	100	65	65	90	55	50	55	35	65
	15	65	80	50	50	55	65	60	65	90	70	50	75	50	30	80
	20	*40*	*70*	*75*												
Uniformity Factor (U)		2			2			2			6			12		

†These numbers are not footcandles, but must be divided by window height to find lamp spacing that will produce 200 footcandles in a selected zone. See text.
*Multiply illumination factors by 2.0 for 300-watt R-40; 3.1 for 500-watt R-40; 0.4 for 75-watt R-30.
**Multiply illumination factors by 1.7 for 300-watt PAR-56 medium flood with wide section of beam perpendicular to glass.

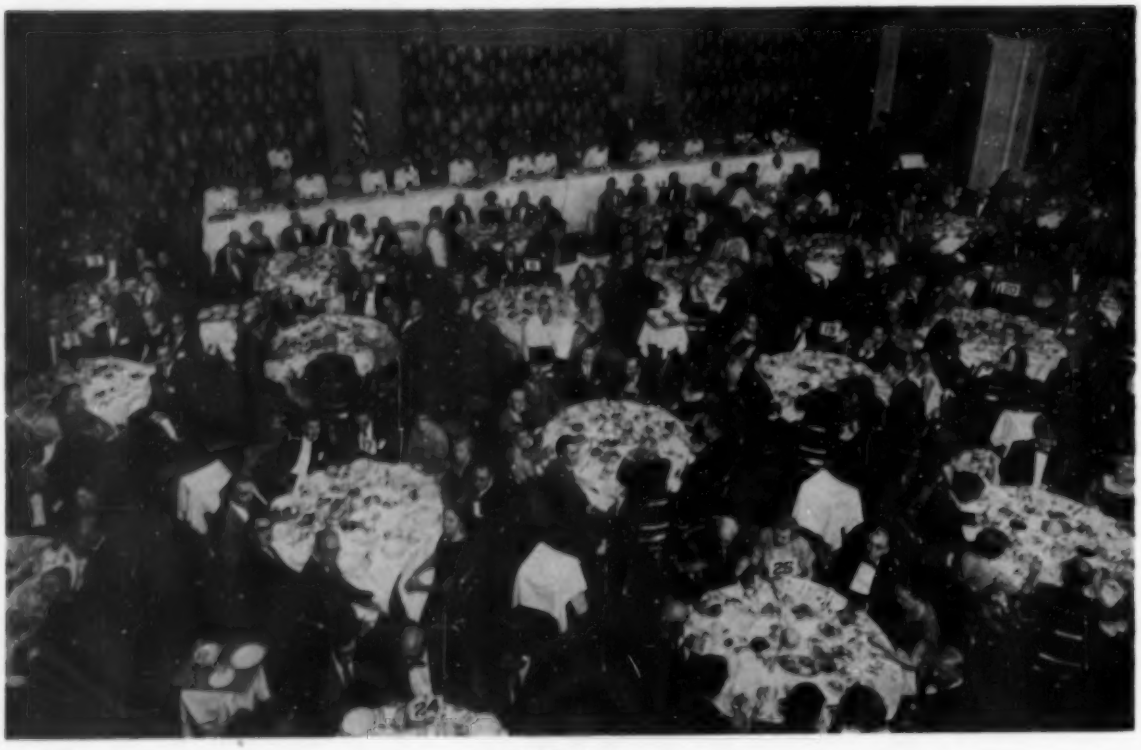
5. If desired, find illumination in the other zones according to these relationships:

$$\frac{\text{footcandles in zone } A}{\text{footcandles in zone } B} = \frac{F_A}{F_B} \quad \text{and} \quad \frac{\text{footcandles in zone } C}{\text{footcandles in zone } B} = \frac{F_C}{F_B}$$

5. Using PAR-38 floods on 10-inch centers, there will be 200 footcandles in zone *B*. To find average zone *A* footcandles: footcandles in zone *A*/footcandles in zone *B* = F_A/F_B or, footcandles in zone *A* = footcandles in zone *B* × F_A/F_B = 200 × 65/80 = 163 footcandles. Similarly for zone *C*: footcandles in zone *C* = 200 × 40/80 = 100 footcandles. Using R-40 floods at a 25-degree aiming angle, illumination would average 200 footcandles in all three zones.

6. If a value of illumination other than 200 footcandles is desired in a particular zone, proceed as in steps 1-3 above. Then multiply the lamp spacing found in step 3 by $\frac{200}{\text{desired footcandles}}$**. Illumination in other zones will be greater or less in the ratio of** $\frac{\text{desired footcandles}}{200}$**. Uniformity should be checked as in step 4.**

6. If 300 footcandles are required in zone *B* using PAR-38 floods, the lamp spacing should be: 10 inches × 200/300 = 6.7 inches. Illumination in zone *A* = 163 × 300/200 = 244 footcandles. Illumination in zone *C* = 100 × 300/200 = 150 footcandles. Since lamp spacing is decreased, lateral uniformity is even better than before. If R-40 floods at 25 degrees are to be used, spacing for 300 footcandles would be 6.25 inches × 200/300 = 4.16 inches. Since this is less than the lamp diameter, a double row of lamps at twice the center-to-center spacing (8.32 inches) could be used. Or, preferably, 300-watt R-40 floodlamps on 8.32-inch centers should be used.



The Banquet.

SOME HIGHLIGHTS OF THE CONFERENCE

Two Presidents — At left, retiring President Jones prepares to hand the official gavel to incoming President Hartenstein, who will present him with the all-gold Past-President's pin.

Tennis balls indicate IES members gained and lost in Kirk Reid's presentation of the General Secretary's Report.

TELECAST

LIGHTING NEWS OF CURRENT INTEREST

1955 National Technical Conference

In its pre-conference billing, Cleveland adopted the slogan "Come to Cleveland in 1955 — You'll Be Glad You Did." Nearly a thousand people *did* come, and *are* glad they did.

By whatever yardstick one might apply, the 1955 National Technical Conference in Cleveland was large. Large, meaning successful. Large meaning many people. Really big, in terms of its scope and importance. As though spurred by the size and success of the nine Regional Conferences last Spring, the Committee planning this meeting left no doubt that this was *National*.

Lest one assume that registration alone is the criterion, reference to the numerous other phases is recommended, especially the technical program, the invited papers, and the special sessions. So valuable were these parts of the I.E.S. meeting that some 164 of the general public registered for individual sessions, in addition to the officially registered delegates. The Committtee this year inaugurated a policy of special registration at $2.00 for single-session attendance, giving an opportunity for many non-members to hear I.E.S. papers of special interest to them.

Report to Members

Ever since the very first I.E.S. Convention, one of the most important sessions has always been the opening Annual Report to the Members. This is the "state of the union" address by the President, the incoming President, and the General Secretary. Interest in it is, naturally, considerable. Printed versions may be read in Illuminating Engineering, but the dramatization of facts and figures is possible only in a personal presentation. This was especially true of the General Secretary's Report as given by Kirk Reid. In a spirit of fun as well as seriousness, he dramatized the membership story, for instance, with a basket of tennis balls (tennis being one of his well-known hobbies). Each represented about 200 members. Many were added to the basket as new elections. Also, many were withdrawn as delinquents and resignations. These were tossed back to Section representatives in the audience. Their ball. There were laughs, of course, but never before had that many members of I.E.S. really understood so fully the significance of membership trends. Similar gimmicks were indulged in to bring home to those listening other phases of the Society's operation. Fun, but very, very effective. Colored slides of on-the-job shots of Headquarters staff was another interesting innovation in this report.

All of these addresses may be read in IE. President Jones' report on the past year may be found on page 405, September issue; President Hartenstein's "Looking Ahead in 1956" on page 408, September issue. The General Secretary's report in full detail, is scheduled for publication in the December 1955 issue of IE.

IES Gold Medal is presented to J. L. Stair by President D. M. Jones, a highlight of the opening session. See page 14A for Mr. Stair's acceptance address.

Statistics
National Technical Conference

Time: September 12-16, 1955
Place: Statler Hotel, Cleveland, Ohio
Attendance:

Registered Delegates	563
Ladies	186
Individual registrations for one or more sessions	164
Total	913

Banquet Attendance: 590
Sections/Chapters Represented: 54
Attendance Award Winner: New Orleans Section

At the close of the session, President Jones introduced a distinguished visitor from France, Professor Georges Destriau, who also was scheduled later in the week to present a paper. Professor Destriau spoke to the convention, bringing best wishes for success of the meeting from the French I.E.S., Société Francaise des Eclairagistes.

Gold Medal Award

Presentation of the highest honor in illumination was made during the opening session to J. L. Stair, a Past-President and Fellow of I.E.S. Mr. Stair was introduced by Dr. George Crampton, President of the Society in 1921-1922. The I.E.S. Gold Medal was presented to Mr. Stair by President Jones, together with a certificate bearing the citation:

The Illuminating Engineering Society Medal Awarded To J. L. Stair

Past President and Fellow of the Society. For two score years his creative, ever-fresh approach to applied illumination was a potent stimulus to the advancement of the lighting art. Master of Technology, he was no less a leader in creating lighting environments characterized by eye comfort and aesthetic fitness. Pioneering in graphical presentation of lighting ideas, he was uniquely effective in furthering appreciation of illuminating engineering

among members of the architectural profession. Active in the Society throughout his career, his stimulating personality and professional integrity have been a continuing benign influence in its committees and councils.

On the Occasion of the
National Technical Conference
of the
Illuminating Engineering Society
Cleveland September 12, 1955

Mr. Stair is the tenth man to receive this award, the highest in the Society, since its inception in 1944. Complete text of his acceptance address is given in a separate column.

C.I.E. Report

Delegates attending the opening session were especially interested to hear the report on last summer's Congress of the Commission Internationale de l'Eclairage, given by Dr. Ward Harrison, retiring C.I.E. President. Full text of Dr. Harrison's summary is given in a separate department of this Conference report (page 20A).

Fellow Pins Presented

Another ceremony of particular interest at the Monday morning session was the presentation of the coveted white lapel pin denoting Fellow Grade, to twelve distinguished new Fellows. Introduction of the Fellows was made by Henry L. Logan, Chairman of the Board of Fellows. Citations and Fellow pin were presented by President Jones to:

C. L. Amick: "For his contribution to the standardization of fluorescent lighting, to the improvement of lighting calculations with line sources, and to the literature of fluorescent lighting."

L. E. Barbrow: "For contributions to photometric methods and standards."

A. C. Barr: "For contributions to the design and operating techniques of hot and cold cathode fluorescent lamps, and improvements in their color spectrum."

B. S. Benson, Jr.: "For his contribution to fluorescent application techniques, particularly fluorescent ceilings."

A. H. Clarke: "For his pioneering developments and application of floodlighting equipment."

C. L. Cottrell: "For his contributions in the field of visibility research."

C. D. Gibson:* "For his contributions to both daylighting and artificial lighting techniques in the educational field."

Carter Lewis: "For his contributions to lighting education throughout the Middle West."

W. A. Pennow: "For his contributions in the field of airport and aviation lighting."

Mary E. Webber: "For original experimentation, and development of successful lighting techniques in the residential lighting field."

C. E. Weitz: "For literary contributions to the progress of illuminating engineering."

C. A. B. Halvorson, Jr.: "For pioneering inventions of street-lighting and floodlighting sources and accessories and their application."

*Absent. Pin will be mailed.

Group of Canadian delegates to the Conference surround their Regional Vice-President Hastings and President and Mrs. Jones.

Retiring members of Council are applauded. Left to right are: M. B. Hastings, Canadian Regional V-P; F. C. Winkler, Director; C. J. Berry, East Central Regional V-P; M. J. Myers, Southwestern Regional V-P; J. F. Whitehead, Director; Glenn Park, Southern Regional V-P and E. M. Strong, Past-President.

Technical Program

A complete list of the program is included at the end of this report, for the record. Fourteen separate sessions were featured on the program, some of them parallel, one of them an evening event. The successful practice of the past several years was followed for two special sessions on (a) Environment and (b) Residential Lighting Forums. Invited papers were presented at these sessions, before an audience so big the doors couldn't be closed. These seems no question that lectures of this nature are extremely popular, both with the regular delegates and the general public. Featured this year were papers on "Architecture and Our Neglected Senses" by Eric Pawley, Washington, D. C., architect, and "Interior Color Planning, Is It Art or Engineering?" by Walter C. Granville, color specialist with Container Corporation of America, Chicago, Ill.

Four excellent presentations on residence lighting were given Tuesday morning at the Residence Lighting Forum Session, with Miss Mary B. Tiepke of Detroit Edison Company as chairman.

Details of this session are also given at the end of th report.

Progress Report

Standing-room only was again the situation for the Progress Report. This was an evening event on Tuesday, and was attended en masse, including the ladies. E. W. Beggs, Chairman emceed, as well as participated. Everybody enjoyed the session, as well as seeing for themselves all of the significant developments in lighting during this past year. Several of these developments were put across by means of skits, all much fun.

Lighting Competition

This part of the program is another S.R.O. event. The contest for "My Most Interesting Lighting Job" is one of the most popular as well as practical of I.E.S. projects. This is true at the Section and Regional contests, and it goes double for the National level where the finalists compete for the top prize. The competition is under the direction of the Lighting Service Committee, Lee E. Tayler, Chairman. This year's contest was the biggest so far, in terms of numbers participating. Some 48 of the Sections and Chapters held local contests. Winners of these competed at the Regional contest in all ten I.E.S. Regions. Listed below are the ten Regional winners who completed for four prizes at the National Technical Conference. The installations presented by the four winners are shown in the articles and papers section of this issue.

First Prize — $100.00: George C. Schroeder, Southern Region, New Orleans Section. "Crippled Children's Hospital."

Second Prize — $50.00: Harold Fisher, Great Lakes Region, Michigan Section. "Westminster Church."

Third Prize — $25.00: H. M. White, East Central Region, Maryland Section. "Baltimore Memorial Stadium."

Progress Report — At left, Progress Report Committee Chairman Gene Beggs. In skit, at right, J. H. McCulloch, Mrs. Ruth Beggs, and Master Huie McCulloch.

Participants in the Progress Report.

Publicity for IES took various forms: At left, R. F. Hartenstein, President-Elect was interviewed by Jane Stevens over Station WJW, one of six radio and television broadcasts from Cleveland stations by IES delegates. At right, one of the several store windows featuring IES displays during the Conference.

Fourth Prize — $15.00: Gordon L. Dovey, South Pacific Coast Region, Southern California Section. "Ball Point Pen Factory."

Runners-up: H. R. Nellis, Canadian Region. "Church Lighting."

David M. Demaree, Inter-Mountain Region. "Gymnasium Lighting."

E. L. Garber, Midwestern Region. "Church Window."

Randall H. Rice, Northeastern Region. "Small Private Airport."

Floyd A. Covington, Sr. and Jr., Southwestern Region. "Art Galleries."

Prize checks were awarded to the winners at a special ceremony during the banquet. The suspense, and subsequent rejoicing, was of course considerable.

Of Special Interest

The Statler Hotel was buzzing with I.E.S. activity the entire week of the conference. Most of it was related, of course, though not all of it official. For example:

An "Industry Women's Dinner," now almost an annual fixture was arranged by Mary Taepke, and attended by some twenty business women (lighting business) registered at the conference. Women active in residence lighting also attended a special luncheon at Monaco's Restaurant as guests of E. W. Commery.

Twenty-six Illini Allumni, all delegates at the conference, got together for lunch at Stouffer's Tuesday noon. The illustrious names signed up for this indicate the University of Illinois is a veritable cradle of I.E.S. talent.

Those not present at the conference should try to get a copy of *The Venetian Blind*, a single-issue newspaper prepared by the Display and Decorations Committee, with Bill Johnson as editor. Satire so subtle it sneaks up on you. Since its distribution was in connection with a "Futurama" party Monday evening (see Social section), its time-relation is one-hundred years hence, or in connection with the Society's 149th Convention. Dateline, September 12, 2055. One phase of its news deals with the I.I.E.S. (Interplanetary Illuminating Engineering Society), the logical next step in I.E.S. growth. Do get a copy.

This wasn't all the Display and Decorations Committee did. They were, of course, responsible for the very professional "sets" used during papers sessions and the Progress Report, but in addition successfully arranged I.E.S. Conference displays in numerous Cleveland store windows. Some of these included ticket offices of American Airlines, Capital Airlines, and in the windows of the Second Federal Savings & Loan Co., and Mills Cafeteria.

Committee meetings were confined to Friday, following the final bang of the conference gavel. Friday's crowded agenda, however, spilled over into many early morning breakfast meetings which terminated well ahead of the session opening.

Professor Russell Putnam conducted tours of the new E.E. Building at Case Institute on Friday, September 16. This building has a new photometric laboratory and several different lighting systems.

Contestants in the contest for "My Most Interesting Lighting Job."

President Jones, left, congratulates First Prize winner George C. Schroeder, Jr., with MMILJ Contest Committee Chairman Lee Tayler at right.

Press and Radio

As befits a conference of this nature, press, radio and TV interest was considerable. Coverage was excellent. Newspapers covered most sessions, some with direct staff representatives, some from releases obtained from the I.E.S. Press Room. J. J. Neidhart of Westinghouse was in charge of this activity, and hardly got to hear a paper himself, so busy was the Press Room. Six radio and television broadcasts were made from Cleveland stations featuring I.E.S. delegates. Seen and heard were:

WTAM — Mary Taepke and Katherine Goodall on the Gloria Brown-Mildred Funnel Show.

WOAR — Mary E. Webber, Ruth Allen Program.

WHK — Frank Wyatt of the Chicago Park District, "Preventing Traffic Accidents with Light." Eleanor Hanson Show.

WJW — R. F. Hartenstein, I.E.S. President-Elect. Interviewed by Jane Stevens.

WERE — Duncan M. Jones, I.E.S. President, interviewed by Wayne Johnson.

WEWS — Gene Rae, Holophane, on "Safety in the Home." Dorothy Fuldheim Program.

Strictly Social

I.E.S. talent shows up in whatever they do. Divertissements at the Cleveland conference were clever, gracious,

(*Continued on page* 13A)

CURTIS LIGHTING....
more than DESK TOP DEEP

With an eye for beauty and performance, Architects Bissell and Belair and Consulting Engineers, G. M. Orr Engineering Company, chose Curtis Alzak Aluminum Forty-Sixty luminaires for the Concord Elementary School in Edina Morningside District No. 17, Minneapolis, Minnesota.

These Forty-Sixty units designed and engineered by Curtis have proved this beauty to be more than desk top deep. They are as efficient and economical as they are beautiful. Based on the principle of semi-direct lighting, the indirect component of 40% directed upward practically eliminates ceiling contrast and the direct component delivers 60% of the output to the desk working area. This level of 48.5 footcandles of glare free illumination with a desirable VCI of 95+ provides a classroom lighted to exceed A. S. A. standards. Curtis Processed Alzak aluminum and the parabolic design of the reflector combines to give the Forty-Sixty an efficiency that provides high levels of quality illumination with only two rows of luminaires. Units of ordinary design usually require three rows. The resultant savings of installation and initial equipment costs is as much as 30%. The hard-as-diamond Alzak finish requires a minimum of maintenance, provides a lifetime of service. This economy of installation and maintenance meets the most rigid school budgets.

Whether you are building new or modernizing existing classrooms, remember to achieve efficiency and economy in your lighting it must be more than desk top deep. Write M41-CS for details today.

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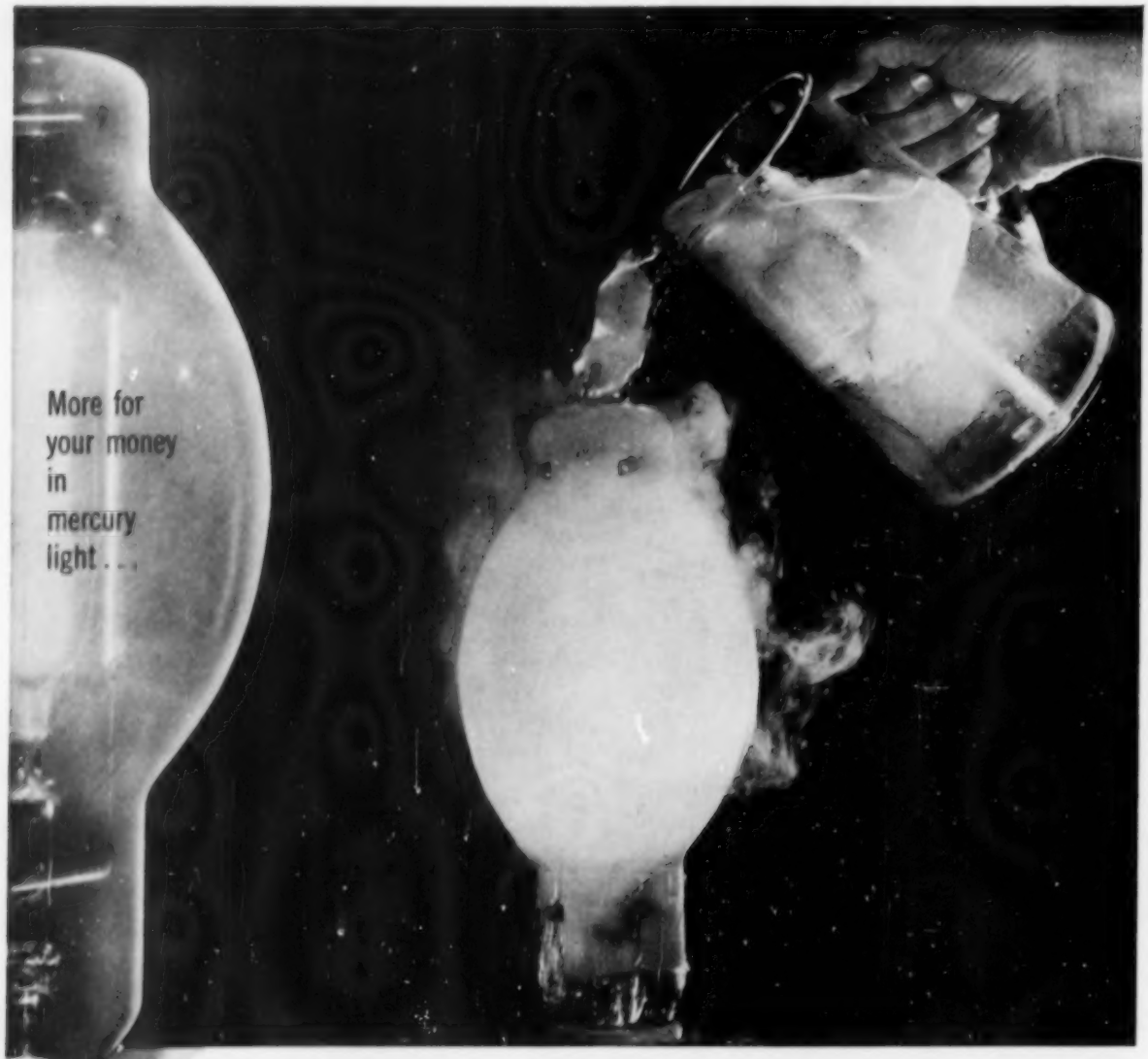

ANNOUNCING NEW WESTINGHOUSE WEATHER DUTY™ MERCURY LAMPS

Down again go your lighting costs as Westinghouse announces another basic improvement in high-intensity mercury lamps. It's the world's first line of *weather-resistant*, heavy-duty mercury lamps.

Made with hard, tough, thermally stable glass, new Westinghouse WEATHER DUTY Mercury Lamps can be burned outdoors unprotected in rain, snow or sleet with no risk of cracking. And they can be burned indoors in ventilated fixtures with no danger of shattering under water drops entering through the ventilating openings. Moreover, they are highly resistant to mechanical breakage and to the corrosive effect of industrial fumes.

Thus in any type of installation—indoor or outdoor—Westinghouse WEATHER DUTY Mercury Lamps save you money three new ways. First, by eliminating the need for protective shields and permitting the use of cheaper fixtures. Second, by doing away with costly shield maintenance. And third, by releasing the large amount of light wasted by dirty shields.

WEATHER DUTY Mercury Lamps are the latest example of how Westinghouse gives you "*more for your money in mercury light.*" Now available types E-H1-WD, J-H1-WD, A-H12-WD, C-H12-WD, A-H15-WD and B-H15-WD.

WESTINGHOUSE GUARANTEES the service life of all its widely used types of quartz mercury lamps. For full details call your Westinghouse Lamp Representative—or write Westinghouse Lamp Div., Dept IE, Bloomfield, N.J.

YOU CAN BE SURE...IF IT'S Westinghouse

(Continued from page 10A)

and lots of fun. Probably what contributed to the most fun was the typical I.E.S. sociability — mass participation. Everybody was in everything, together. Cleveland night spots got short shrift from this convention.

"I.E.S. Futurama — What Is to Come in the Year 2000" was a review staged for the edification of all, its theme obvious from the title. This was the entertainment Monday night (September 12). Joseph Terr was its planner. Personnel from some six different Sections made up the cast. The Sections' skits — terrific all of them — competed for a Grand Prize, a space helmet. It's hard to say which was funniest, but the applause meter registered highest for the Chicago Section's parody on "This is Your Light!" Its author was Carl Jensen of Westinghouse, Chicago; the actors were Eric Church, Bob Diefenthaler, Ernie and Mrs. Gallet, Jerry Marks and Joe Schneller. Personnae dramatis for all of the skits is not available, which is too bad because they were very very good.

Tuesday night was the Progress Report. This is quite properly listed in the program for both the serious section and the Divertissements.

On Wednesday the early fall weather turned just warm enough to add still further pleasure of over 900 I.E.S.'ers who attended the International Night at Nela Camp. Whoever on the committee took the gamble that it would be o.k. to move nearly a thousand people so far from Convention base, won, hands down. Chartered buses took them all the ten miles to Nela without a hitch. Some went swimming. Some played shuffleboard or ping-pong. All 900-odd were fed with fishes and loaves (among other things) in an amazingly short time. Hundreds of tables were set up under the breezeway and under the biggest tent outside of Ringling Bros. After dinner, hundreds of chairs were quickly lined up with Nela-like magic on the grass before a raised platform for the evening's entertainment. This was provided by Cleveland's famous Nationality groups, five of whom did folk dances, in authentic costumes of their nationality. Each group provided for its own musical accompaniment, and authentic foreign instruments. Lighting for this event was from a 75,000-watt lamp installed on the Breezeway roof. Another feature of the evening was the out-door garden, with garden lighting designed by Mary Webber, which had been set up on the Camp grounds.

President and Mrs. Duncan M. Jones were honored Thursday night, with a Reception and Banquet, attended by 590

(Continued on page 14A)

Fish Fry — Over 900 people at Nela Camp — lined up for fish dinner.

Entertainment later was by five nationality groups of Cleveland, who did dances native to their nationality.

(Continued from page 13A)

members and guests. This was, of course, the social highlight. It was also the scene of a number of awards, including the M.M.I.L.J. contest already reported. President Jones, during ceremonies at the Banquet, awarded:

Attendance Gavel — Again won by the New Orleans Section. Fifth time in a row for this Section. This award, established in 1914, is given to the Section or Chapter having the greatest number of members registered in relation to the miles traveled to the conference and percentage of membership. The anvil which goes with it is the gift of the British Columbia Section, winner of the award in 1948.

Membership Prize—won by the Golden Gate Section, and accepted by L. B. Craig of the Membership Committee for that Section. Eight other first prizes were received by Board Members or by Regional Vice-Presidents representing the winning groups.

Sustaining Membership Prize — was won by the Chicago Section. Their S-M Chairman, Louis Rosenstein received the certificates for himself and his Co-Chairman Paul Kauffman. The other winner was the Oregon Section, whose certificate was taken home for them by one of their own attending members.

Golf Awards — The President Law trophy, an individual competition on an 18-hole handicap basis, was won by Max D. Orr of Chicago Section. The Regar Cup, placed in competition for Section and Chapter Teams was captured by the Cleveland Section. Their team: Edward Rich, Norman Vacha, Robert Kelly and Keith Nesbitt.

President and Mrs. Jones themselves were the recipients of a present. Beautiful silver candelabra were presented by Conference Chairman Charles Amick, on behalf of the host Section, Cleveland.

Through the years it has been a tradition of the Society to present to the President as he completes the year of his service, the all-gold Society Emblem, which is worn only by the Presidents of I.E.S. This Past-President's Emblem

(Continued on page 16A)

Gold Medal Acceptance Address

By J. L. Stair

Mr. President, Dr. Crampton, I.E.S. Friends and Guests:—

About three months ago Mr. Edward Hopper received a gold medal for painting, awarded by the National Institute of Arts and Letters. I understand that he was informed, to his great relief, that all he need say on the occasion was one word — "THANKS." Since in this instance I was not so informed, I presume that I am under compulsion to be more voluble and, therefore, I shall say at least these eight words — "My warm and sincere thanks to you all."

In my almost 40 years of association with the Illuminating Engineering Society, this is without question the finest, the most jewel-like moment, and I wish that I might respond adequately by expressing my gratitude in fresh, unhackneyed terms, but after all words are but empty thanks.

I am profoundly moved by this distinction and when I contemplate being classed with the talented and illustrious members that have previously been given this award, I am struck with a deep feeling of humility.

This medal and this scroll, which I gratefully accept, will be fondly cherished — least for their mere intrinsic worth; greatly for their symbolic meaning; and most of all for their sentimental significance, because they reveal a wholly unexpected measure of esteem and praise of friends and colleagues, all of whom have given depth and vitality to my experiences.

But I cannot accept the award for myself alone — whatever contribution I have been able to make has not in the largest measure been of my own making. For in this hour of personal honor there stands before my mind's eye a picture of all those associated with me in any and all endeavors.

I see all these included in this ceremony as co-sharers in this citation. Without their loyalty and generosity; without their faith and support, there would be no gold medal for me. Accordingly, I prefer to consider that I hold this award in trust, as a cherished symbol of what we have accomplished together.

There is special significance to me in the fact that this award is being made in the distinguished city of Cleveland — the home of Nela Park — The University of Light — the great nerve center of lighting research and development, where many of us have attended stimulating sessions of professional instruction, in Nela's ivy-covered halls, in their pleasant campus-like setting.

It is a particular pleasure indeed to receive the award at the hands of President Duncan Jones, whom I salute as a valued friend and as a former associate in the business of making and applying equipment for good lighting.

I should like to salute also the man whom you have just heard interpret the history and purpose of the Society's Gold Medal, because he typifies to me a distinctive species of I.E.S. member, known as the past-officer; in this case a past-president. The durable Dr. Crampton was our president one-third of a century ago, and has during the intervening thirty-three years served the Society with interest and loyalty. There is something in the man and something in our organization that evokes such a large and continued measure of devotion. One reason lies in the fact that the I.E.S. values the counsel of those who have served as officers in the past and that it endeavors to keep them active — a tribute to our organization.

I have no sage advice to propound. However, I should like to address this thought to the younger members:— It is you that will bind the past and the future together; you that will carry on the true and noble mission of our Society. It is obvious that we cannot lean back upon our victories; depend upon the glamour of the past to sustain us or the momentum of our success to advance the arts that we profess — our opportunities and responsibilities are ever-increasing.

Engineering, perhaps more than any other profession, is, because of its youth, a calling dependent upon fellowship and close cooperation for its advancement. Therefore, I say to our younger members, cheerfully embrace all calls to service — help the I.E.S. grow in stature and proficiency.

In terms of your particular gifts and abilities, give what you have to give. Do this and your association with the I.E.S. will be a happy and rewarding experience and our society will remain worthy and retain the enviable position it now holds in the technical field.

Remember this also — We of the I.E.S. are the "KEEPERS OF THE LIGHT," given us in trust, not only to keep alive and glowing, but also to pass on with fairer and increased radiance.

Again I say, my warm and sincere thanks to you all.

ENGINEERS: YOU CAN SPECIFY BETTER LIGHTING WITHIN PRICE LIMITS OF LOW-COST SYSTEMS

WHEN YOU CHOOSE THE GIBSON ortho-77®

WITH THE EXCLUSIVE UNI-RACE*

10 MODELS IN ORTHO-77 LINE

The Gibson Ortho-77 fixture is ideal for office, stores and school lighting. Superbly constructed, durably finished. Beautifully designed. Highly efficient. ETL approved components. UL approved. Union made. Gibson quality throughout.

Rule-of-thumb shows that fixtures represent about 50% of the total cost of a lighting system. The other 50% goes for installation and materials. That is why Gibson designed its ORTHO fixtures and exclusive UNI-RACE.

Because the UNI-RACE is so simple and quickly assembled *on the floor* . . . and because GIBSON ORTHO fixtures can be installed so fast . . . actual savings in labor and materials on installation are as high as 50%.

This means that better lighting is possible within the limits of low-cost installations and restricted budgets.

Get full details and specifications on the ORTHO-77 and UNI-RACE from your Gibson representative, or write direct.

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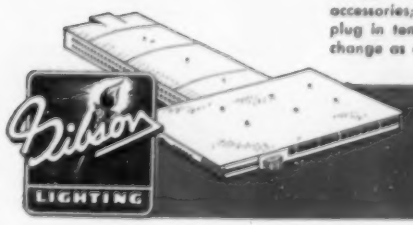
THE EXCLUSIVE GIBSON UNI-RACE*

This rigid channel wireway has a shock-proof outlet for each fixture, providing a permanent anchor and fixed power source. The Uni-Race can be easily and quickly assembled into sections up to 48 feet long, wired complete on *the floor*, then raised and hung as a unit—directly to the ceiling, stems, or I-Beam and Bulb-Ts through the use of special clamps. Alignment and spacing for fixtures are automatic. Fixtures can be hung by two men, without tools, at the rate of 45 to 55 per hour—in continuous rows or at any interval of 4, 8, 12 or more feet. Spacing can be changed, more units added, repairs made at any time without additional electrical work and without interrupting service to other fixtures on the circuit. The Uni-Race saves on conduit, receptacles, accessories; eliminates aligning extras. It can be shipped in *advance* of fixtures and outlets used to plug in temporary lighting during final construction and painting. Ortho-77 fixtures are as easy to change as a light bulb—anyone can do it, no tools or special skills needed.



GIBSON Manufacturing Co.

Ladies Entertainment Committee — left to right: Seated, Mrs. Raymond Green, Mrs. Frank Mueller, Mrs. Charles Amick; standing, Mrs. William Kahler, Mrs. Norman Vacha and Mrs. J. C. Forbes.

Mrs. Jones and Past-Presidents' wives at the Fashion Show: Mrs. D. M. Jones, Mrs. W. C. Brown, Mrs. W. F. Little, Mrs. A. F. Wakefield, Mrs. J. L. Stair, Mrs. Ward Harrison, Mrs. C. H. Goddard, and Mrs. L. E. Taylor.

Box luncheon in Mrs. Raymond Green's garden — Carol Forbes entertained the other half of the group.

Fashion show and lunch at Higbee's Auditorium.

(Continued from page 14A)

was pinned to Mr. Jones' lapel by the incoming President, R. F. Hartenstein, and the official gavel in turn given to Mr. Hartenstein.

Ladies Program

The Cleveland wives were smart too. Their ladies' program, headed by Marion Mueller and Ruth Kahler was as smooth as the rest of the conference, and a big success with the 186 women who attended. They had their own Headquarters in the Pine Room of the Statler, and gathered there every morning for coffee and further cementing of new-found friendships. On Monday they attended a Basket Brunch at Halle's (department store), and on Tuesday had box lunches in the gardens of two local members' wives. One group were entertained at the J. C. Forbes homes, another simultaneously at the Raymond Green's. After lunch a large group went to the Karamu House, famous inter-racial theatre. Rehearsals for "The King and I" were in progress. Wednesday noon the women attended a luncheon and fashion show at Higbee's, and of course participated in International Night at Nela Camp that evening. Trips and events on Thursday, boat trips and such, were all timed so that everyone got back in time to dress for the ball.

Credits

The whole Cleveland Section should be congratulated. Almost every member participated in this conference to some extent. The chairmen of the committees listed below had responsibility for the various activities, and their work was

(Continued on page 19A)

Constitution Hall, Washington, D. C.

(DAUGHTERS OF THE AMERICAN REVOLUTION)

•

RELIGHTED BY RAMBUSCH UNDER THE SUPERVISION OF
BERNARD LYON FRISHMAN & ASSOCIATES, *Architects* • L. WARREN BOGAN & ASSOCIATES, *Consulting Engineers*

When it comes to lighting large and lofty interiors the Rambusch Downlite has no equal. It is efficient, safe, economical, simple to maintain, glare shielded and guaranteed to produce the promised results. • There are 100 Rambusch lighting representatives in the country—one of them is near you and anxious to serve you.

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NOW G. E. adds 7% more light to world's most powerful fluorescent lamp: G-E High-Output

G-E High-Output lamps score higher light meter readings than any other fluorescent lamps.

The 8-foot sizes are now available in De Luxe Warm White and De Luxe Cool White, marked as shown here.

All three sizes of G-E High-Output lamps are ideally suited to outdoor applications like this.

2 new colors, 2 new sizes, too

7% MORE LIGHT. Already the most powerful fluorescent lamp available, the General Electric High-Output has now been given a 7% higher light rating.

This was done by filling the tube with pure argon gas. This also increases the rated wattage to 105.

Net result, for most users, is lower overall cost of light.

BETTER FOR OUTDOOR USE. Because they're filled with argon gas, G-E High-Output lamps now give dependable starting even at 0° F. And they give much more light at low temperatures. Starting voltage is lower in cold weather. This means lower cost ballasts and permits use of present lamp holders.

NOW IN IMPROVED COLORS. The 8-foot G-E High-Output fluorescent lamps are now available in De Luxe Cool White and De Luxe Warm White. They give as much light *with* improved color as any other 8-foot fluorescent lamp *without* it. Stores and offices can now get more flattering light without increasing the number of fixtures.

NEW SIZES FOR FLEXIBLE DESIGN. You can now get G-E High-Output lamps in 4 and 6-foot lengths, Standard Cool and Warm White. These shorter lengths permit flexible layout.

Ballasts and sockets for all three sizes of General Electric High-Output fluorescent lamps are available now. For more information, write Large Lamp Department, General Electric, Dept. 482- IE-11, Nela Park, Cleveland 12, Ohio.

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(*Continued from page 16A*)

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Milwaukee, Wis.

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W. W. Booth — C. W. McCormick
G. F. Dean — G. E. Park
J. C. Forbes — A. C. Sangster
M. B. Hastings — L. E. Tayler
A. D. Hinckley — A. S. Turner
R. M. Zabel

1955 Conference Executive Committee

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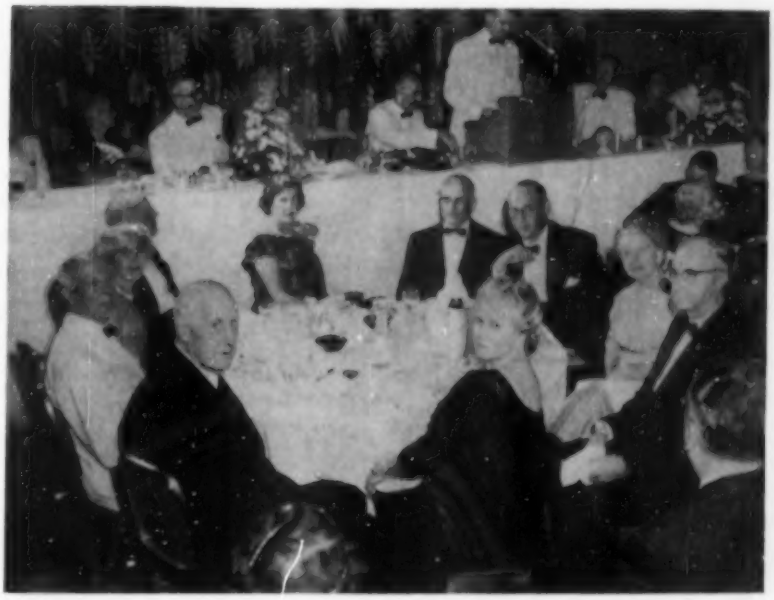

One of the Past-Presidents Tables at the Banquet.

Meeting Room Committee

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D. G. Mallory — T. Summers
R. H. Woods — J. R. Bale

Transportation Committee

Chairman, J. G. Mitchell
Grant Electric Co., Cleveland, Ohio

Registration and Reception Committee

Chairman, E. I. Creed
C & S Lighting Maintenance Co.
Cleveland, Ohio

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TECHNICAL PROGRAM

National Officers Report

Monday Morning, September 12th

Presiding—C. N. Laupp, Wisconsin Electric Power Co., Chairman, National Technical Conference Committee.

Opening Remarks

Report of the General Secretary—K. M. Reid, General Electric Co.

President's Address — D. M. Jones, Curtis Lighting of Canada.

Our Society in 1955-1956 — R. F. Hartenstein, Ohio Edison Co.

Introduction of Fellows:
Presentation by President Jones.
Introduction by H. L. Logan, Chairman of the Board of Fellows.

Presentation of I.E.S. Medal to J. L. Stair
Introduction by George S. Crampton, Chm., Medal Committee.
Presentation by President Jones—Response by Mr. Stair.

The 1955 C.I.E. Meeting — Dr. Ward Harrison, Past President, International Commission on Illumination.

Greetings from Société Francaise des Eclairagistes — Prof. Georges Destriau.

Light Sources Session I (Parallel)

Monday Afternoon, September 12th

Session Chairman — E. H. Salter, Electrical Testing Laboratories, New York, N. Y.

Discussion Organizer — L. B. Keiffer, General Electric Co., Cleveland.

Phosphor Stabilization for Better Lamp Performance — H. H. Homer, K. H. Butler, M. J. Bergin, Sylvania Electric Products, Salem, Mass.

The Effect of Various Metal Electrodes on Brightness Waves in Electroluminescence—Professor Georges Destriau, Faculté des Sciences, Paris, France.

(*Continued on page 20A*

(Continued from page 19A)

Effect of Bulb Wall Temperatures on Fluorescent Lamp Parameters — C. W. Jerome, Sylvania Electric Products Inc., Salem, Mass.

Residential Technical Session (Parallel)

Monday Afternoon, September 12th

Session Chairman — F. J. Marriett, Thomas Industries, Inc., Louisville, Ky.

Discussion Organizer — N. H. Vacha, Whiteway Stamping Co., Euclid, Ohio.

Methods of Lighting Pictures in Residences — Eve Freyer, Westinghouse Electric Corp., Bloomfield, N. J.

Engineered Home Lighting Using Prismatic Lenses and Refractors — Clarence Keller, Holophane Co., Inc., New York, N. Y.

Luminous Interiors for the Home — E. W. Commery, General Electric Co., Cleveland, Ohio.

Residence Lighting Forum (Parallel)

Tuesday Morning, September 13th

Session Chairman—Mary Taepke, Detroit Edison Co., Detroit, Mich.

Light for Outdoor Living (Garden Lighting Demonstration)—Myrtle Fahsbender, Westinghouse Electric Corp., Bloomfield, N. J.

Decorate with Light — Visual Demonstration, Valances and Portable Lamps — Katharine Goodall, Philadelphia Electric Co., Philadelphia, Pa.

Light on Family Fun at Home — Visual Demonstration and Slides, Light for Family Recreation — Mary E. Webber, General Electric Co., Cleveland, Ohio.

Color and Architecture in Homes — Slide Presentation — H. Creston Doner, Libbey-Owens-Ford Glass Co., Toledo, Ohio.

Calculations Session (Parallel)

Tuesday Morning, September 13th

Session Chairman — Bernard F. Greene, Consulting Engineer, New York City.

Discussion Organizer — Benjamin S. Benson, Jr., Benjamin Electric Mfg. Co.

Graphical Determination of Illumination by Solid Angle Projection Methods — J. O. Kraehenbuehl, University of Illinois, Urbana, Ill.

Measured Utilization Data for Luminous Ceilings — A. H. Russell and R. D. Churchill, General Electric Co., Cleveland, Ohio.

A Design Procedure for Luminous Ceiling Lighting — Julius N. Robertson and Glenn E. Hutchcroft, Department of Water and Power, City of Los Angeles, Calif.

Applications I (Parallel)

Tuesday Afternoon, September 13th

Session Chairman — J. A. Schneller, Lighting Products Inc., Highland Park, Ill.

Discussion Organizer—R. G. Slauer, Sylvania Electric Products, Inc., Salem, Mass.

Quality and Economical Aspects of Parking Area Lighting — J. R. Bale, Westinghouse Electric Corp., Cleveland, Ohio.

(Continued on page 25A)

The 1955 C.I.E. Meeting, Zurich

By Ward Harrison

There were some seven hundred people in attendance at Zurich; five hundred and twenty delegates and one hundred and eighty lady guests. Of the delegates, more than one hundred came from Great Britain; about eighty-five from Germany; fifty to sixty from Switzerland and an equal number from France. The USA delegation was next with thirty-six plus twenty-two ladies. The smaller and more distant countries, Turkey, Israel, Australia and Japan had only one or two delegates present. South Africa was an exception with four.

A very beautiful and impressive feature of that opening session, which I shall never forget, was the solid background of twenty-six flags which extended clear across the platform —one for each of the nations represented in the Commission, their folds overlapping in a most friendly manner. A few short years ago, just the sight of one of those flags would, in many countries, have sent deadly missiles flying.

For the first time since World War II Russia had delegates present throughout the meeting. Two of them were professors at the University of Moscow where they are in charge of a four-year course in illuminating engineering with an attendance of two hundred students.

To digress for a moment, you must realize that Russia is turning out twice as many trained scientists and engineers each year as graduate from our American colleges, and they are well-trained men. For some reason, the proportion of our high school graduates who plan on scientific or engineering courses in college has fallen from seventeen per cent to ten per cent in the past few years. Every engineer in this room knows some high school students and he should feel it his personal responsibility to do something about correcting the situation. If we can't keep up with Russia in science and engineering, we shall certainly lose out to it in economic or military competition. In Russia, a full professor is allotted six times the income of a skilled artisan, a carpenter or a mason. Some similar yardstick is badly needed in America.

The Russians at Zurich spoke only in Russian. They had quite a personable interpreter with them but she spoke only French. Our conversations together consisted of my saying something in English, which Carl Atherton kindly translated into French and which the interpreter then translated into Russian. After a while the reply came back to me via the same route. These Russians had pleasing personalities, were men whom you would have been glad to know, and they took part constructively in the work of the Commission. They also attended the entertainments and weekend excursions.

For the first time at any meeting of the Commission each delegate was supplied with ear phones and by pushing the proper button, he could hear the presentations in either French, German, or English, as he chose. This simultaneous interpretation was a tremendous time-saver for it obviated the usual translations into the two other official languages after the speaker had completed his remarks in the third language. Also, for those like myself who are lamentably unlearned in foreign tongues, it eliminated the boredom of listening to a speaker for one-half to three-quarters of an hour, understanding nothing that he has said.

Our chief interpreter at Zurich had been the chief interpreter for United Nations in Geneva. It was amazing the way these people could give you a translation of a sentence or a complete paragraph just two or three words behind the speaker.

Now you may ask what is the purpose of the International Meetings, and that is a very good question. In return, I will ask you why you are now in Cleveland today. You have monthly IES meetings in your own city and also an annual conference for your own region. Certainly, you do not consider the men in your own area inferior to others in ability or originality in the design of lighting installations and yet you are eager to go to the National Conference. The answer is, of course, that you welcome the opportunity to exchange ideas and to learn first hand what the other fellow is doing. And that, likewise, is the motivating force that brings people to the meetings of the International Commission. Certainly the best brains of the lighting industry of Europe are assembled there and ready to talk.

Except for the ear phones and one feature known as the plenary session, the conference at Zurich was not so different in plan from our meetings this week in Cleveland. Here, we

(Continued on page 22A)

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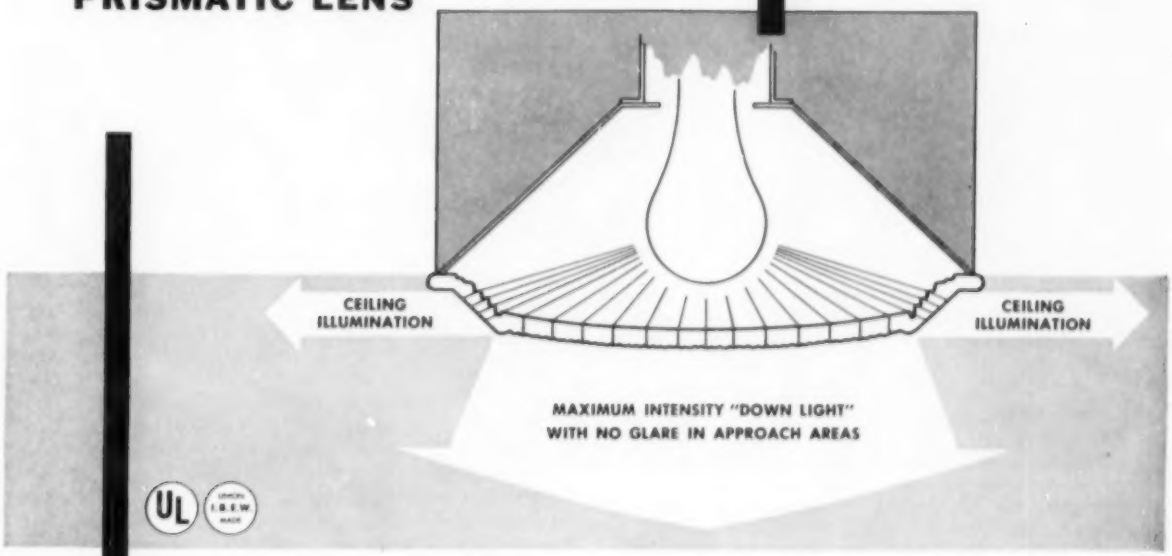

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C.I.E. Meeting, Zurich, by Ward Harrison

(Continued from page 20)

are to have four days of sessions, with a total of thirty eight papers. The International, which meets only once in three or four years, had a week and a half of sessions (eight working days and covered sixty-eight papers and reports. Just as here, there were often two parallel sessions; one covering basic subjects and the other applications.

Some of you may harbor the opinion that we in America have little to learn about lighting from other countries. It is true that, generally speaking, our illumination levels are higher than theirs and our installations frequently cover much larger areas. On the other hand, lighting done in a wholesale way is often lacking in the niceties and the completeness in every detail which is characteristic of European work. Every one of the American delegates who attended the meetings at Zurich will tell you that they found much that was worthwhile.

You may be interested in a few of the high spots. In the street lighting field, the Dutch had a paper which gave the results of studies as to the comparative discomfort glare from street lamps of different spectral qualities. This, you will agree, is something that it would be difficult to determine with accuracy out-of-doors at night. It is likewise not easy to duplicate outdoor night conditions in a laboratory. The ingenious method by which this was accomplished excited the admiration of the delegates.

There was a lively discussion on all phases of street lighting — on the continent the primary interest is in fluorescent. The city of Munich alone has over ten thousand such luminaires, probably more than are in use in all America. They were predominantly two-lamp equipments and were frequently placed over the center of the roadway and sometimes parallel to the direction of the street to minimize glare. It was stated that in Germany, fluorescent streetlighting installations, although higher in first cost, would pay back the difference within three years.

Ever since the introduction of fluorescent lighting the French have banned its use in schools on the ground that it might be harmful to children's eyes. At Zurich, however, the French delegation announced that the ban had been lifted. It's my own opinion that discussions at our International Conference had considerable to do with their change in attitude.

The question of fading of art museum exhibits when shown under fluorescent light is a subject frequently discussed. At Zurich, several countries reported authoritatively that more damage is done by daylight than by fluorescent lamps.

Lighting equipment for use in hazardous or corrosive situations commands more attention abroad than in the U. S. There was an excellent presentation on this subject and the same was true of mine lighting. In France, xenon is used as a filling gas for the bulbs in miner's cap lamps.

You all know that there has been a great difference of opinion between the U. S. and Europe as to what constitutes the best pattern for automobile headlights. The Codes were so at variance that Americans taking their cars to tour the Continent have sometimes been required to install new headlights at their port of entry, and at a cost of as much as $50.00. Considerable progress has been made toward coordinating the different viewpoints. There is already evidenced a greater tolerance of the other country's equipment.

The Commission has devoted much time and effort to the standardization of the lighting of international airports and of identification lights on airplanes and, just now, similar lights for helicopters.

A paper on electroluminescence brought out that it would take several square yards of such luminous surfaces to provide the same illumination as furnished by our forty-watt fluorescent lamp. It was stated that the possibility of this source becoming a general illuminant was extremely limited for some years to come.

If you are interested in a more comprehensive summary of the papers and reports at Zurich, I would refer you to the September number of the British IES publication "Lamps and Lighting" which should be just off the press. I have been quoting quite a bit to you from a galley proof of this number which the editor kindly sent me for this purpose, at my request. The official proceedings of the conference, running to more than twelve hundred pages, should be available in about six months.

And now, finally, just what is the organization of the International Commission on Illumination. Its official title in French is Commission Internationale de l'Eclairage and from that comes the more frequently used abbreviation CIE. The Commission is entirely independent of any country or government. It has grown out of the interest of individuals of various countries who have felt ever since its origin some fifty years ago that an interchange of information on lighting is a useful thing. The CIE works through National Committees in the various countries and they, rather than individuals, comprise its membership. The President of our U. S. National Committee is Mr. Brainard and our Secretary is Mr. Barbrow. Accordingly, they are members of the CIE Executive Committee which might be likened to our IES Council. Between meetings it is finally responsible for the affairs of the Commission.

In the IES, all matters of policy and all technical reports are passed upon by the Council. The CIE operates a bit differently. I have made reference to the plenary sessions of the CIE. Except for voting, they are something like a New England town meeting where everyone is free to attend and express his views. All important recommendations are discussed and passed upon at these sessions and the officers of the Commission are elected there. The vote is by National Committees and each committee has just one vote whether it is represented by one delegate or one hundred. However, Executive Committee suggestions are generally followed.

The CIE, of course, has no mandatory powers but its recommendations carry much weight with bodies that do, and it maintains close liaison with other international groups, including various sub-divisions of the United Nations.

For the past seven years, the headquarters of the CIE has been in the USA operating under the direction of Carl A. Atherton, the Secretary whom many of you know. I would be quite remiss if I failed to tell you what is acknowledged in all quarters, namely, that our growth and progress during these seven years have, in large measure, been due to Mr. Atherton's efforts and skillful management.

At Zurich, it was decided, and very properly so I think, that the headquarters should now be returned to Europe. Dr. Walsh, for many years associated with the British National Laboratory, is our new President. Professor Le Grand, of Paris, is Secretary, and Mr. Chappat, well-known to many Americans, is his co-worker. He, of course, is also located in Paris and the headquarters, of Central Bureau, as it is termed, will be there. Our Mr. Brainerd is now a Vice-President.

The next International Conference will be held in Brussels four years hence, that is in 1959. Not only the meeting places and the meetings but also the entertainment will be found well worth-while, as it was at Zurich and, previously, at Stockholm and Paris. I am sure that many of you who were not at Zurich will want to plan on Brussels.

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The Prudential is Garcy Lighting throughout. Acres of offices are lighted by more than five thousand Garcy 4-foot troffers, equipped with low-brightness lenses. Many other manufacturers make troffers, but few are equipped to handle complete lighting contracts for a building of the Prudential's size and scope.

Investigate Garcy fixtures . . . engineered for highest efficiency . . . precisely manufactured for fast installation in any kind of ceiling . . . designed for quick, easy cleaning and relamping.

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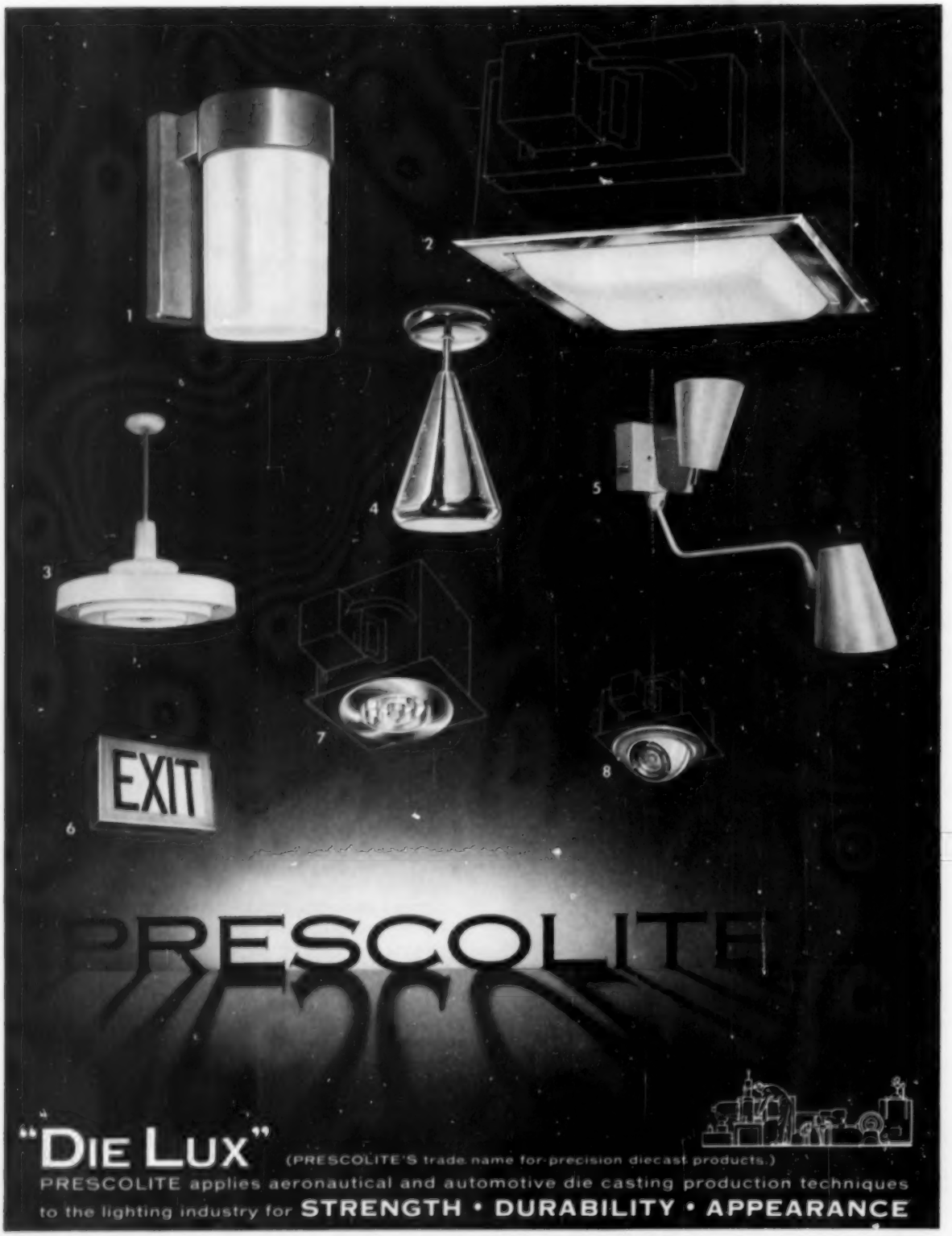

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January 31 Is Deadline For 1956 Conference Paper Outlines

A deadline of January 31, 1956, has been set by the Papers Committee for outlines of proposed papers for the 1956 National Technical Conference. Outlines of proposed papers, in triplicate, should be mailed to:

H. F. Davidson
Chairman, I.E.S. Papers Committee
c/o Hydro-Electric Power Commission of Ontario
620 University Avenue
Toronto 2, Ontario, Canada

(*Continued from page* 20A)

A Study of Lamp Mortality and Lumen Depreciation of Mercury Lamps as a Guide to Lamp Replacement Programs — W. S. Till and M. E. Haskins, Jr., Westinghouse Electric Corp., Bloomfield, N. J.

Show Window General Lighting Design Data for PAR and R Lamps — C. N. Clark, General Electric Co., Cleveland, Ohio.

Signboard Lighting Economics — W. H. Johnson, Westinghouse Electric Corp., Cleveland, Ohio.

Research Session (Parallel)

Tuesday Afternoon, September 13th

Session Chairman — L. E. Barbrow, National Bureau of Standards, Washington, D. C.

Discussion Organizer — Willard Allphin, Sylvania Electric Products Inc., Salem, Mass.

Investigation of the Relation of Changes in Pupil Size to Visual Discomfort — Jack M. Fugate and Glenn A. Fry, School of Optometry, Ohio State University, Columbus, Ohio.

Footcandles for the Forgotten Man — Sylvester K. Guth and Arthur A. Eastman, General Electric Co., Cleveland, Ohio.

Comfort in Lighting—A Report on Discussions at the C.I.E. Zurich Meeting — Sylvester K. Guth, General Electric Co., Cleveland, Ohio.

Lighting Progress — A Demonstration Report

Tuesday Evening, September 13th

Chairman — E. W. Beggs, Westinghouse Electric Corp.

In lighting there's always something **new** — whether it's a fixture, a light source, a technique, or an idea that can be employed in the infinite variety of applications through which lighting serves the public. This dramatic presentation outlines the progress during 1954-55 at home and abroad as assembled and reported by the national committee on Lighting Progress.

My Most Interesting Lighting Job Contest

Wednesday Morning, September 13th

Chairman — Lee E. Tayler, Detroit Edison Company.

Judges: C. L. Crouch, Duncan M. Jones, R. F. Hartenstein, Prof. John O. Kraehenbuehl, Dr. E. F. Lowry.

Alternate Judges: Joseph S. Schuchert, Joe Thomas.

Timer: Richard M. Smart.

Regional Winners:

Canadian: H. R. Nellis, "Church Lighting."

East Central: H. M. White, "Lighting Baltimore Memorial Stadium."

Inter-Mountain: David M. Demaree, "Lighting Holbrook High School Gymnasium."

Midwestern: R. L. Garber, "Revealing Hidden Beauty in Church."

Northeastern: Randall H. Rice, "Lighting Small Private Airport."

Pacific Northwest: W. J. Lind, "Office Lighting Job."

Southern: George C. Schroeder, "Crippled Children's Hospital, New Orleans."

South Pacific Coast: Gordon L. Dovey, "Lighting a Ball Point Pen Factory."

Southwestern: Floyd A. Covington, Sr. and Floyd A. Covington, Jr., "Lighting Art Galleries."

Great Lakes: Harold Fisher, "Lighting Westminster Presbyterian Church."

Light Sources Session II (Parallel)

Wednesday Afternoon, September 14th

Session Chairman — R. P. Teele, National Bureau of Standards, Washington, D. C.

Discussion Organizer — E. F. Lowry, Sylvania Electric Products Inc., Salem, Mass.

Effect of Operating Variables on Mercury Lamp Performance — E. B. Noel and E. C. Martt, General Electric Co., Cleveland, Ohio.

Development and Application of Quartz Infrared Lamps—Morgan Christensen and A. G. Foote, General Electric Co., Cleveland, Ohio.

Some Methods for the Improvement of the Strength of Miniature Lamp Filaments — J. Martin, Westinghouse Electric Corp., Bloomfield, N. J.

Applications Session II (Parallel)

Wednesday Afternoon, September 14th

Session Chairman — H. L. Wright, Curtis Lighting of Canada Ltd., Toronto, Ont.

Discussion Organizer — G. F. Dean, Toronto Hydro-Electric System, Toronto, Ont.

Relative Visibility of Office Tasks — W. S. Fisher and H. M. Schmies, General Electric Co., Cleveland, Ohio.

Visual Comfort and Cost Analyses for Production Lighting — George J. Taylor and R. D. Bradley, Day-Brite Lighting Inc., New York, N. Y. and St. Louis, Mo.

Fluorescent Luminaires for Refrigerated Areas —T. Summers, Westinghouse Electric Corp., Cleveland, Ohio.

Mercury and Filament Lighting Can Be Comfortable Too — E. A. Linsday, Q. D. Dobras and D. B. Phillips, General Electric Co., Cleveland, Ohio.

Architectural Session

Thursday Morning, September 15th

Session Chairman — R. M. Zabel, Westinghouse Electric Corp., Bloomfield, N. J.

Architecture and Our Neglected Senses — Eric Pawley, American Institute of Architects, Washington, D. C.

Interior Color Planning, Is It Aesthetics or Engineering? — Walter C. Granville, Container Corp. of America, Chicago, Ill.

Where the Light Leads — Douglas Haskell, Editor, *Architectural Forum*, New York, N. Y.

Discussion of Above Papers.

Daylighting Session (Parallel)

Thursday Afternoon, September 15th

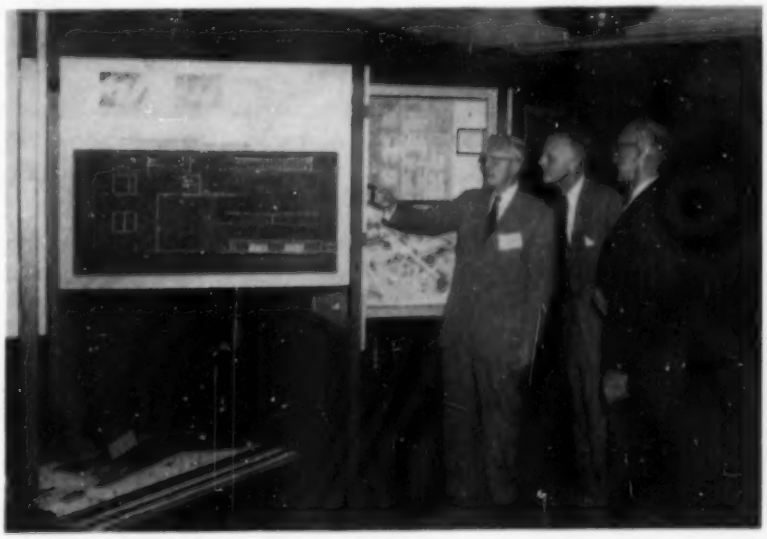
Session Chairman — Robert A. Miller, Pittsburgh Plate Glass Co., Pittsburgh, Pa.

Discussion Organizer — W. P. Lowell, Jr., Sylvania Electric Products Inc., Ipswich, Mass.

Daylighting Design with Overhangs — J. W. Griffith, Southern Methodist University, Dallas, Texas; W. J. Arner, Libbey-Owens-Ford Glass Co., Toledo, Ohio; E. W. Conover, Detroit Steel Products Co., Detroit, Mich.

Acrylic Louver Wall Panels for Classroom Daylighting — E. M. Linforth, Rohm and Haas Co., Philadelphia, Pa.

(*Continued on page* 27A)



Roy Palmer, Willard Brown and Karl Staley study the display of architectural students' entries in the joint AIA-IES-SID competition.

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Modern Savings and Loan Building Beautifully Lighted by Wakefield Beta Units

Here is an interesting pattern of Wakefield Beta units which illustrates the variety of design possibilities open to the illuminating engineer who specifies Wakefield Geometrics. In this smart modern interior three different Beta sizes were used—1′x4′, 2′x4′ and 4′x4′—to give a maintained level of 55 footcandles. (There is still another size: 2′x2′.)

Beta is a recessed unit with a Rigid-Arch Plexiglas diffuser. The diffuser, which distributes the light evenly, with little or no direct or reflected glare, has a matte surface which will not mirror lights from the window when the lamps are turned off. (The Wakefield Omega is a companion unit for on-surface mounting, in the same four sizes.)

Write for a catalog on the Beta and the Omega.

Dearborn Federal Savings and Loan Building, Dearborn, Michigan

Job Engineerd by William Sanders, Electrical Engineer, Bennett and Straight, Architects and Engineers, Detroit

Electrical Contractor: Paas Electric Company, Detroit, Michigan

THE WAKEFIELD COMPANY
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WAKEFIELD LIGHTING LIMITED
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(Continued from page 25A)

Daylight Measurements in Six New England Schools—Willard Allphin, Sylvania Electric Products, Inc., Salem, Mass.

Manufactured Light Versus Daylight for Schoolrooms—Richard F. Hammel, Hammel and Green, Architects, St. Paul, Minn.; Lawrence E. Johnson, Northern States Power Co., Minneapolis, Minn.

Street Lighting Session (Parallel)

Thursday Afternoon, September 15th

Session Chairman — D. A. Toenjes, General Electric Co., Cleveland, Ohio.

Discussion Organizer — G. K. Glass, Detroit Edison Co., Detroit, Mich.

Report of Street, Tree and Utility Conference — Warren H. Edman, Holophane Co, Inc., Newark, Ohio.

Luminaire Light Distribution Principles — Charles Rex, General Electric Co., Lynn, Mass.

Operation of Mercury Vapor Lamps on Series Street Lighting Circuits — C. F. Scholz, M. E. Keck, W. H. Oglesbee, Westinghouse Electric Corp., Cleveland, Ohio.

Effect of Street Lighting on the Night Traffic Accident Rate — Frank D. Wyatt and E. Lozano, Chicago Park District, Chicago, Ill.

Closing Session

Chairman — C. M. Laupp, Wisconsin Electric Power Co.

Report of Committee on Resolutions.

Chairman — A. H. Manwaring, Philadelphia Electric & Mfg. Co., Philadelphia, Pa.

"Working with Light" — Program For Industrial Arts Students

A program of supplementary educational materials, especially designed for use in Industrial Arts and Vocational Education classes, has been prepared by the Commercial and Industrial Lighting Education Committee of the Better Light Better Sight Bureau. The National Education Association, the American Arts Association, the American Vocational Association, the National Association of Secondary School Principals and the National Society for the Prevention of Blindness cooperated in the preparation of the material.

The educational program is built around the integration of instruction on good lighting into the projects and problems of the Industrial Arts own program. Twelve project leaflets present lamp and fixture constructions which provide shop experience such as how to make table lamps in wood, metal and ceramic; floor lamps; driveway and garden units; valance, cove and cornice lighting fixtures; and lamp shades of proper design. Dimensional drawings and instructions give step-by-step procedure.

A 112-page Lighting Handbok for Industrial Arts Classes covers Lighting and Light Control; the Science of Light and Sight; Light Sources, Incandescent and Electric Discharge; Fixtures; Lighting Design; Demonstrations that Illus-

(Continued on page 28A)

Sequel to the Conference. Back home in their Thousand Island Cottage near Brockville, Que., Mr. and Mrs. Jones plant the trees given to them by Kirk Reid. Presidential timber.

Welcoming smiles already, from New England Section members, for Boston in '56.

I.E.S. National Technical Conferences

1956 — September 17-21 — Hotel Statler, Boston, Massachusetts

1957 — September 9-13 — Biltmore Hotel, Atlanta, Georgia

1958 — August 17-22 — Royal York Hotel, Toronto, Ontario

1959 — September 7-11 — San Francisco, California

(Continued from page 27A)

trate Basic Principles; and Construction of Lighting Demonstration Equipment.

Other material in the complete program is a Reference Folder, a 4-page leaflet for use with the project sheets, which contains a summary of the important principles of lamp, fixture and lampshade design.

Project Sheets and Reference Folder, at five cents each, and the Lighting Handbook, at one dollar each, are available from the Better Light Better Sight Bureau, 420 Lexington Ave., New York 17, N. Y.

For the teacher of the industrial arts class, the N.E.A. Manual, "Teaching about Light and Sight," is available from the National Education Association, 1201 Sixteenth St., N. W., Washington 6, D. C. Price upon request to NEA.

First Council Meeting of New I.E.S. Year Convenes in New York City

The new fiscal year of I.E.S. was officially launched October 13. Council held its first meeting of the 1955-1956 administration at the Hotel Lexington, New York City. The newly inaugurated President, R. F. Hartenstein presided; the following members of Council attended: Past Presidents A. H. Manwaring and Duncan M. Jones; Vice-Presidents M. N. Waterman and Kirk M. Reid; General Secretary George J. Taylor; Treasurer J. S. Schuchert; Directors, Brooks Chassaing, G. F. Dean, C. C. Shotwell, W. A. Stannard, L. C. Twichell; Regional Vice-Presidents, James R. Chambers, William Lowell proxy for John G. Felton, J. Dixon Mitchell, Gene Rae proxy for Blair E. Plowman, A. C. Sangster, Joseph Thomas, Nelson C. Warner and W. J. Byrne proxy for J. D. Whitnell; Executive Secretary A. D. Hinckley; Technical Director C. L. Crouch; Editor Ruby Redford; Advertising and Promotion Manager C. E. Ellis; E. M. Strong, Charles Laupp, Fred Guth, Swen Brunn, and James Forbes.

Summary of Action

The first Council customarily has a crowded agenda; this meeting was no exception. The overall budget for the year, presented by the Finance Committee (Warren Booth, Chairman) was discussed and approved. Committee personnel, for both Standing Committees and Technical Committees for the coming year was appointed. Complete lists of all committees with scope and personnel, will be published in the December issue of IE. A number of committee chairmen, who traveled to New York for the purpose, presented to Council their plans for the year. Chief among these were Chairman of the Membership Committee (W. A. Stannard) and of the Sustaining Membership Committee (Fred E. Guth), both of whom have worked up planned programs for effective action.

Membership

In addition to announcing plans for next year, Mr. Stannard presented for Council approval 35 Members, and reported his committee's election of 145 Associate Members and 38 Students. Current membership statistics were shown as follows:

September 30, 1955		October 13, 1955
8178	Total Membership	8313
35	Members Emeritus	35*
89	Fellows	89
1979	Members	2001
5887	Associate Members	5982
188	Student Members	206

*Includes 12 Fellows.

A report on the study recently made by Paul Hildebrand on a proposed Life Membership was made by the General Secretary. Further discussion of Council will be given this proposal following additional study by the Finance Committee.

Sustaining Membership

Fred E. Guth outlined a well-planned full scale campaign for this activity. Some of their plans, aiming at a financial goal of $45,000 included wider participation of all members, letters to all Section and Chapter Chairmen, and a regular news column in IE, each issue. The value of IES to the industry generally will be further pointed up in a program of advertisements in the magazine. Mr. Guth's program is divided into six divisions:

Power and Light Companies
Lighting Equipment Manufacturers
Lamp Manufacturers
Residential Lighting Equipment Manufacturers
Lighting Equipment Distributors
Related Manufacturers

Separate chairmen have been appointed to head up programs for each of these six groups, and future published lists of the Sustaining Members, will be presented under the six categories.

Mr. Guth submitted a motion that it be Council's current intention that any increases from this program (increased dues from present members, and dues from new members) be applied as follows: (a) That the Sustaining member (new or making an increase) may specify how he wishes such funds to be allocated — whether to Research or to other

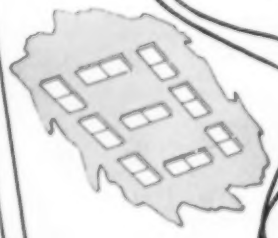
(Continued on page 31A)

INSTALLATION of Officers of the Georgia Section, I.E.S. took place at their September 19 meeting, at the Red Fez Club, Atlanta. Left to right: Saylors Andre, S. M. Pearson, Wesley Johnson, retiring Chairman Paul Harrison, Tom Haslam, incoming Chairman Judd Lough, Johnnie Sweatte, O. V. Scott and Perry G. Sessoms.

NOW!

TROFFER APPEARANCE
TROFFER LIGHTING PATTERNS
Without
TROFFER EXPENSE

WITH *Eastern's* NEW
RECTILINEAR
Illumination



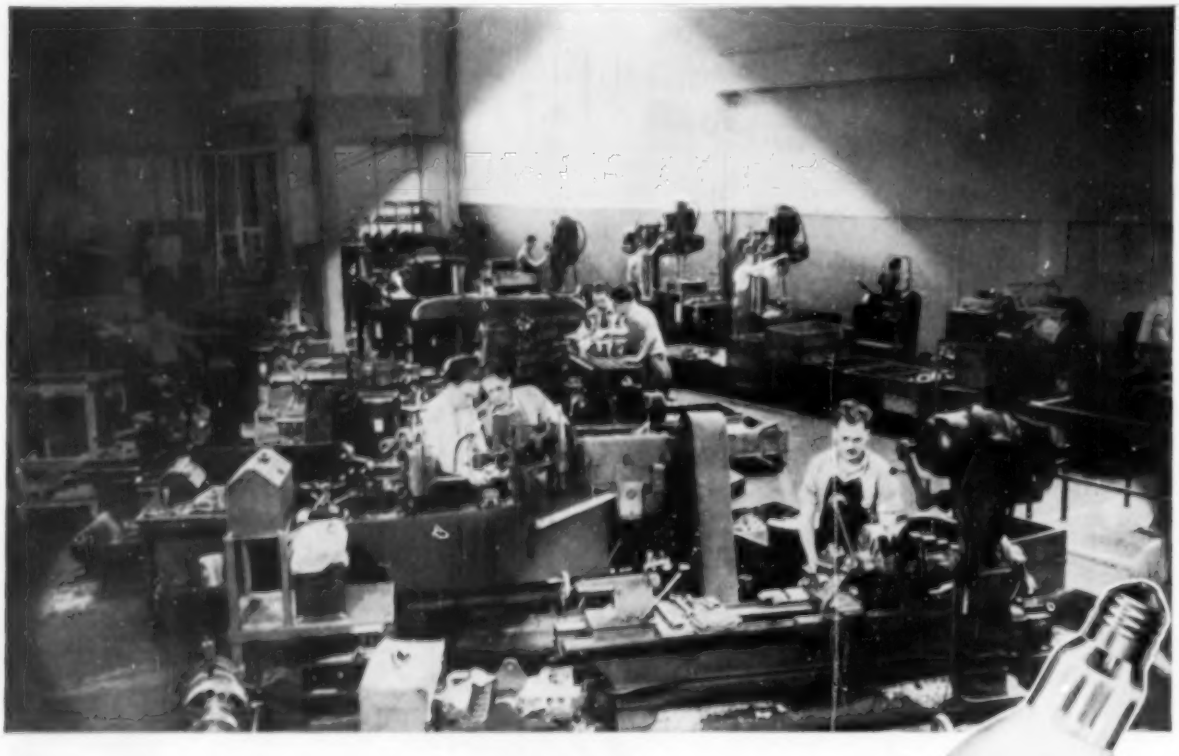
This WF Series Unit is available with 2 or 4 lamps — rapid start only. Send for complete details, ask for WF Catalog Sheet.

Eastern ENGINEERED

EASTERN FIXTURE COMPANY
170 VERNON STREET, BOSTON 20, MASS.

NOW...

this much "golden white" light from a single 400-watt mercury-vapor lamp



SYLVANIA J-H1 mercury-vapor lamp

HERE'S THE LAMP that opens new vistas in lighting . . . SYLVANIA's new, color-improved mercury-vapor lamp, type J-H1.

With this new lamp, you get more "golden white" light . . . without the color distortions you expect from a clear mercury lamp . . . 18,000 lumens of "golden white" light . . . in a lamp that lasts over two years in normal industrial use. That's more than twice the output of an incandescent lamp of equivalent wattage.

Relight with Sylvania J-H1 color-improved mercury-vapor lamps from your Sylvania supplier today.

FOR THE FULL STORY

on Sylvania mercury-vapor lamps, write for the free booklet "More Light for Less Money."

Dept. 5L-3511,

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1740 Broadway, New York 19, N. Y.
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LIGHTING · RADIO · ELECTRONICS
TELEVISION · ATOMIC ENERGY

Keep your eye on SYLVANIA

...fastest growing name in sight

FIRST Fall meeting of the Arizona Section, September 14, at Cafe Macayo in Phoenix. Ray Jonas (right) retiring Chairman, says "Take it" to Bevan Jones, Chairman for 1955-56.

(Continued from page 28A)

National Society services. (b) Lacking specification, approximately two-thirds of such new or increased funds will be allocated to Research, and one-third to other National Society services.

Mr. Guth, Chairman of the Sustaining Membership Committee, recommended the election of seven new Sustaining Members. These are:

Great Northern Mfg. Corp.
1056 N. Wood St.
Chicago, Ill.
Official Representative: J. Epstein

Ideal Industries, Inc.
1000 Park Ave.
Sycamore, Ill.
Official Representative: Gordon B. Koch

Jeryl Lighting Products, Inc.
42 W. Cermak Road
Chicago, Ill.
Official Representative: Chas. Meyerson

Portland Electric & Plumbing
905 S. W. 16th Ave.
Portland 5, Oregon
Official Representative: Ned Higgins

Pyle National Co.
1334 N. Kostner
Chicago 51, Ill.
Official Representative: A. G. Voelkner

Tri-Part Mfg. Co.
934 Plum St.
Detroit 1, Mich.
Official Representative: Julius Reznik

Wigdahl Electric Co.
4246-48 Milwaukee Ave.
Chicago 41, Ill.
Official Representative: Thomas J. Wigdahl

1959 Conference

Council approved a recommendation from the National Technical Conference Committee (J. C. Forbes, Chairman) that the 1959 Conference be held in San Francisco. Dates for the meeting were also approved—September 7 to 11, 1959.

Mr. Forbes also reported on attendance at Cleveland—and noted that special celebrations for the Society's 50th Anniversary were under way for the 1956 Conference in Boston. Confirmations were made of an active Task Committee for the Anniversary, headed by R. G. Slauer as Chairman.

In further connection with the Golden Anniversary, the Publications Committee was authorized to develop a suitable seal or insignia. Subject to its approval by Mr. Slauer, such seal would be permitted for use on the advertisements of Sustaining Members of I.E.S. throughout 1956, and could be used on the letterhead of Sections and Chapters.

Putting on "another hat," as Chairman of the Civil Defense Committee, Mr. Forbes presented for Council approval the joint Civil Defense and IES report. He noted that this was to be published by the Civil Defense Authority as a guide to Civil Defense units, and requested Council's permission for the use of the Society's name as authority for the material on lighting. So approved.

Regional Activities

A meeting of this group has been held October 12, prior to Council, details of which were reported by Kirk Reid, Chairman. He noted especially that the Regional V-Ps were standing by to aid all possible on Anniversary celebrations. At their meeting they had also studied local finances, led by George Taylor, and programs for good team work locally with

(Continued on page 32A)

LIGHTING CALENDAR

Society Events

April 5-7, 1956—Southern Regional Conference, Birmingham, Ala.

April 8-10, 1956—Southwestern Regional Conference, Hilton Hotel, Fort Worth, Texas.

April 12-13, 1956—South Pacific Coast Regional Conference, San Francisco, Calif.

April 19-21, 1956—Pacific Northwest Regional Conference, Davenport Hotel, Spokane, Wash.

April 26-28, 1956—Inter Mountain Regional Conference, Utah Hotel, Salt Lake City, Utah.

May 7-8, 1956—Great Lakes Regional Conference, Commodore Perry Hotel, Toledo, Ohio.

May 10-11, 1956—Midwestern Regional Conference, Severin Hotel, Indianapolis, Indiana.

May 17-18, 1956—Canadian Regional Conference, Chateau Frontenac, Quebec, Canada.

May 24-25, 1956—East Central Regional Conference, Shoreham Hotel, Washington, D. C.

September 17-21, 1956—Illuminating Engineering Society, National Technical Conference, Hotel Statler, Boston, Mass.

Industry Events

November 13-18, 1955—American Society of Mechanical Engineers' Diamond Jubilee Annual Meeting, Congress, Conrad, Hilton and Sheraton-Blackstone Hotels, Chicago, Ill.

November 14-18, 1955—National Electrical Manufacturers Association, Annual Meeting, Traymore Hotel, Atlantic City, N. J.

November 14-18, 1955—Chicago Exposition & Power and Mechanical Engineers ASME, Chicago Coliseum, Chicago, Ill.

November 28 - December 1, 1955—Ninth Air Conditioning & Refrigeration Exposition, Auditorium, Atlantic City, N. J.

January 23-26, 1956—Plant Maintenance & Engineering Show, Convention Hall, Philadelphia, Pa.

January 23-26, 1956—National Rural Electric Cooperative Association (14th Annual Meeting), St. Louis, Missouri.

January 30 - February 3, 1956—American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler, New York, N. Y.

February 26-29, 1956—National Electric Sign Association, Annual Convention, Jefferson Hotel, St. Louis, Mo.

February 23-24, 1956—12th Annual National Adequate Wiring Conference, LaSalle Hotel, Chicago, Ill.

March 12-16, 1956—National Electrical Manufacturers Association, Edgewater Beach Hotel, Chicago, Ill.

June 4-7, 1956—Edison Electric Institute, 24th Annual Convention, Atlantic City, N. J.

Week of June 10, 1956—National Association of Electrical Distributors (48th Annual Convention), Ambassador-Chelsea Hotels, Atlantic City, N. J.

June 25-29, 1956—American Institute of Electrical Engineers, (Summer & Pacific General Meeting), San Francisco, Calif.

June 27-July 5, 1956—International Electro-Technical Committee, Munich area of Southern Germany.

October 1-5, 1956—American Institute of Electrical Engineers (Fall General Meeting), Morrison Hotel, Chicago, Ill.

October 2-4, 1956—Canadian Electrical Manufactureres Association (12th Annual Meeting), Sheraton Brock Hotel, Niagara Falls, Ontario, Canada.

October 22-24, 1956—American Standards Association, 38th Annual Meeting (In conjunction with Seventh National Conference on Standards), Hotel Roosevelt, New York, N. Y.

October 22-26, 1956—National Safety Council, 44th National Safety Congress & Exposition, Chicago, Ill.

November 12-16, 1956—National Electrical Manufacturers Association (Annual Meeting), Traymore Hotel, Atlantic City, N. J.

(Continued from page 31A)

the publications aims of the Society, led by J. S. Schuchert.

A request for departure from specified meeting practice was approved for the Iowa Section. This group requested approval of three half-day conferences per year, instead of the eight monthly meetings laid down by the By-Laws.

Regional V-Ps present reported individually for their respective constituents. All indicated that they were attending at least one meeting in each of their Sections and Chapters, with close cooperation on all programs.

New Pan Handle Chapter

Kirk Reid presented a petition from a group of members in Amarillo, Texas, for Chapter Charter. With all qualifications met, approval was made for a Chapter there, to be known as the Pan Handle Chapter.

Technical Program

The annual meeting of the Technical Committee Forum was announced. This important gathering of all chairmen of technical committees will be held this year November 14-15 in Columbus, Ohio. Theme of their program will be "Application of Researches on Quality." C. L. Crouch, Technical Director, reported in detail on the activities of each of the technical committees.

Presented for letter ballot of Council were the following committee reports:

Lighting for Commercial Kitchens, presented by the Institutional Lighting Committee.
I.E.S. Guide for Electrical Measurement of Mercury Vapor Lamps, and
I.E.S. Guide for Light Performance Testing of Fluorescent Lamps, reports of the Testing Procedures Committee.

Favorable letter ballot of four reports previously submitted to Council, were reported. Approved for publication as I.E.S. committee reports were the following:

Lighting and Air Conditioning, submitted by the IES-ASHVE Joint Committee.
Lighting Outdoor Locations of Central Station Properties, submitted by the Industrial Lighting Committee.
Current Lighting Practices for Color Television Production, submitted by the Television Committee on Lighting for Production.
Revision of 1947 Recommended Practice of Office Lighting, submitted by the Office Lighting Committee.

J. Dixon Mitchell, Regional Vice-President of the Southern Region, presented a formal invitation from the Alabama Chapter to hold the April meeting of Council in Birmingham, Alabama the day prior to the Southern Regional Conference there, scheduled April 5 and 6. Council approved scheduling their meeting in Birmingham April 4.

Light-Sight Panels Presented By Georgia Groups

A series of Light-Sight Panels, with emphasis on school lighting, were jointly planne dand presented during the first half of this year by the Georgia Section of IES, the Georgia Optometric Association and the Georgia Chapter of the American Institute of Architects. Plans are being made to continue the series throughout the state during the remainder of this year and in 1956.

The programs have been presented in six schools in various sections of the state and on a radio broadcast. Local Parent Teacher Associations sponsored the series and the Superintendent of Schools or his representative in each locality served as moderator. The panel consisted of a representative each from IES, AIA and GOA.

Attendance totaled over 300 for the six panel sessions, and the broadcast was made over Station WEAS. An outline of the program includes introductory remarks by the moderator and presentation of the panelists, who cover the topic as follows:

School Design — AIA representative
School Lighting — IRS representative
School Vision — GOA representative.

A question and answer period and summary completes each session.

Office Lighting Clinic Opens New Series

The first of the 1955-1956 clinics, sponsored by the Chicago Lighting Institute and the Chicago Section of IES in cooperation with other interested groups, was on Office Lighting. The full-day meeting was held on October 20, with the Building Managers Association of Chicago as co-sponsor.

The program, planned for architects, interior decorators, building and office managers, electrical contractors and lighting engineers, began with inspection of the Chicago Lighting Institute headquarters and a welcome by Carl W. Zersen, Managing Director of the Institute. Milton H. Anderson, Vice-President of the Office Management Association, and Manager of Office Service and Equipment with W. A. Alexander and Co.,

(Continued on page 35A)

ST. LOUIS SECTION meeting of September 22, at which new officers were instal'ed. In photo at left, l. to r.: Charles Zurheide; Dudley Sanford, guest speaker; C. Carter Lewis; retiring Chairman Brooks Chassaing; incoming Chairman E. W. Stohlmann, Jr.; Fred Guth; R. J. Welch; and Dick Cohen. Another highlight of the evening was the presentation (photo at right) by Brooks Chassaing, right, to C. Carter Lewis, left, of an engraved pen and pencil set, in recognition of his election to Fellow grade in I.E.S.

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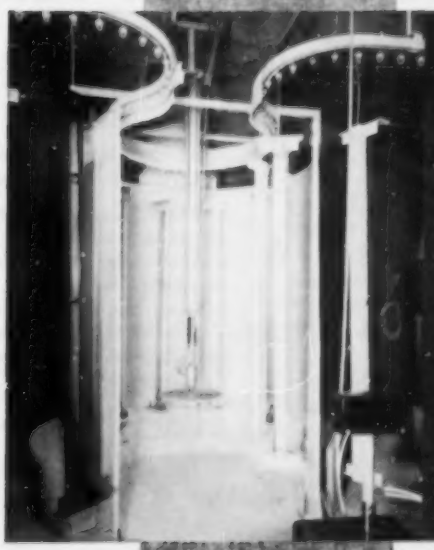
Fluorescent Fixtures of California

the symbol All-Brite LIGHT OF THE WEST of progress in

FLUORESCENT LIGHTING



New Electrostatic Paint Process—first of its kind in the lighting industry—insures highest quality finish for all painted All-Brite parts.

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Write for Catalog B-115

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Main Office and Plant: 352 Shaw Road • South San Francisco
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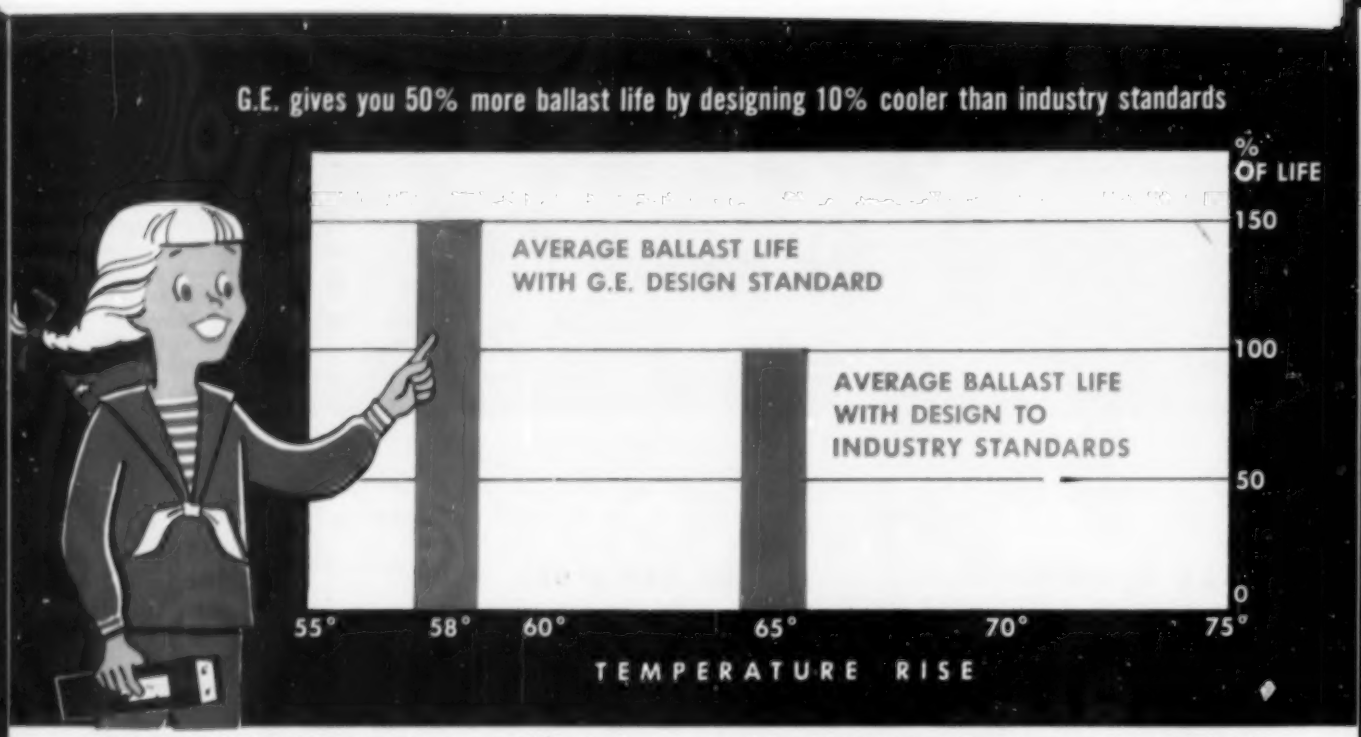

BECAUSE G-E BALLASTS ARE engineered to operate 10% cooler than industry standards, they offer 50% longer life in your fluorescent installation. With this chart, Flora shows you the extra ballast life you get when you specify General Electric's cooler operating ballasts.

Flora* shows you why . . .

General Electric Ballasts Last 50% Longer, Help You Save Lighting Dollars

Every G-E ballast is designed to operate 10% cooler than industry standards; the chart above shows that this means 50% longer ballast life! To you, this means longer life for your fluorescent installations and a real saving in lighting dollars.

By carefully filling each ballast with a special heat-conducting compound, and by using larger wire size in the coil windings than would be required simply to meet industry standards, G.E. builds ballasts that operate cooler! Cooler operating temperatures combined with the use of unusually strong insulating materials results in years of added ballast life.

These special G-E techniques contribute toward lower operating temperatures, resulting in 50% longer ballast life.

Next time you specify equipment for a fluorescent lighting installation, make sure you get the best . . . specify General Electric longer-life ballasts.

A G-E ballast tag or sticker on your fixture is proof that it's equipped with a superior ballast; G-E ballasts in your installation mean better, more efficient lighting, more economical operation. For further information on G-E ballasts, write Section 401-10, General Electric Company, Schenectady 5, New York.

*Miss Fluorescent Ballast, G.E.'s Ballast Mascot

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G-E BALLASTS ARE constantly spot-checked for normal or abnormal temperature rise in this special lab. Close control of temperature rise helps assure 50% longer G-E ballast life.

Five more reasons why

GENERAL ELECTRIC IS YOUR BEST BALLAST VALUE

- **EXCLUSIVE SOUND RATING SYSTEM**
- **SUPERIOR QUALITY CONTROL**
- **PRECISE LAMP-MATCHED DESIGN**
- **PROVED PRODUCT LEADERSHIP**
- **COMPLETE CUSTOMER SERVICES**

Progress Is Our Most Important Product

GENERAL ELECTRIC

(Continued from page 32A)

Chicago, was Chairman of the morning session.

Seeing Problems in Offices — Characteristics of visual tasks; external factors which affect the ability to see — Ben F. Avery, General Electric Co.

Environmental Influences in Offices — Psychological aspects of color; effects of light on color; brightness ratios of surrounds and equipment — Gerge Harles, Commonwealth Edison Co.

Lighting Requirements in Offices — Visual efficiency as related to visual comfort — W. S. Fisher, Jr., General Electric Co.

Light Sources for Office Lighting — Incandescent and fluorescent lamps — L. E. Innis, Sylvania Electric Products, Inc.

Lighting Systems for Offices — Factors influencing their selection — George Gilleard, Curtis Lighting, Inc.

The afternoon session was under the chairmanship of James R. Sterling, Secretary of the Building Managers Association of Chicago.

Lighting for Health and Safety — Air Purification; corridor and stairwell safety — Ralph R. Lusk, Commonwealth Edison Co.

Keeping Pace with Modern Building Design — Coordination between architect and lighting specialist — Charles Wiley, Skidmore Owings & Merrill, Architects and Engineers.

Tour Via Slides of Some Modern Offices — Discussion on each installation — W. C. Mescher, Public Service Co., Division of Commonwealth Edison Co.

Economics of Soap and Water — Maintenance methods for maximum benefits — Carl J. Jensen, Westinghouse Electric Corp., Lamp Division.

Quiz Panel and Summary — Audience doing the quizzing — Walter H. Sobel, Sobel and Stein, Architects and Engineers.

Richard M. Smart, Regional Sales Engineer, Sylvania Electric Products, Inc., was Chairman of the Office Clinic Planning Committee.

SECTION CHARTER is presented to the Northwestern Ohio Section by Vice-President of the Great Lakes Region, Al Sangster. Left to right are: V-P Sangster; Section Chairman Arthur P. Hammerstrom; and Past-Chairmen Robert M. Taylor, Creston H. Doner and Hayden E. Carney. Presentation was made at the September 29 meeting.

San Diego Chapter Initiates C. M. Thompson Award

At its final meeting of last fiscal year, the San Diego Chapter of I.E.S. announced the formation of the C. M. Thompson Honorary Annual Award, presented to stimulate activity for the advancement of the Chapter.

First recipient was, naturally, the Charter Chairman C. M. Thompson who received a scroll citing him for his contributions in the formation of the Chapter and its efforts in furthering the objectives of the Society.

The award is to be presented annually, at the October meeting, to the selected member of the Chapter. Judges will be appointed by the Chapter Chairman.

Plant Maintenance Conference To Feature Fifty Sessions

Fifty sessions on 26 aspects of factory upkeep will highlight the seventh annual Plant Maintenance and Engineering Conference, to be held in Philadelphia on January 23-26. The program will be arranged in three groups: (1) two general conferences, (2) eight concurrent sectional conferences, and (3) sixteen concurrent informal round tables for discussions of special problems. Each of the eight sectional conferences and sixteen round tables will be repeated during a second evening.

All-Industry Planned Lighting Campaign Underway in Pittsburgh

The 1955-1956 All-Industry Training Program and Planned Lighting Contest in the Pittsburgh area got underway early in October.

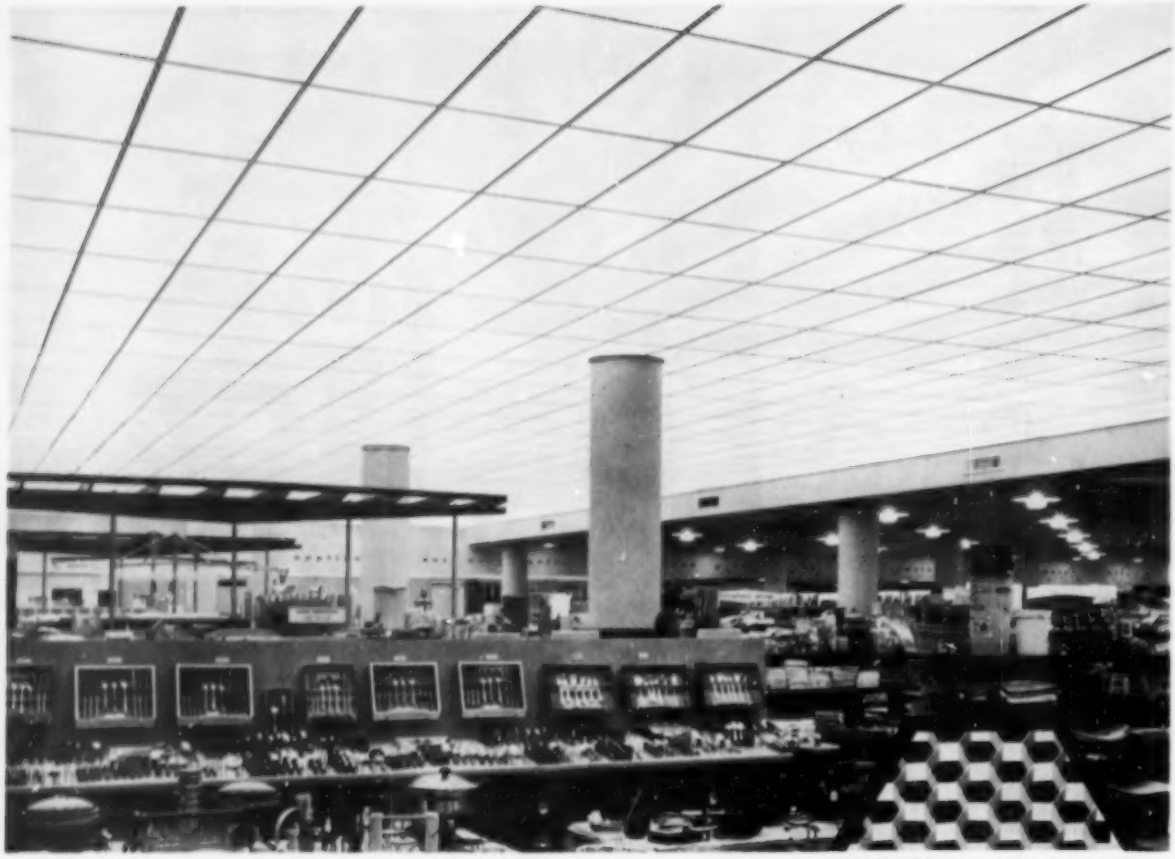
The Training Program consists of the Lighting Fundamentals course, Advanced Lighting Design Problems course, and the Wiring Design course, sponsored by the Pittsburgh Section of IES and the Electric League of Western Pennsylvania.

The course on Lighting Fundamentals is a series of eight weekly two-hour

(Continued on page 40A)

1956 Regional Conferences

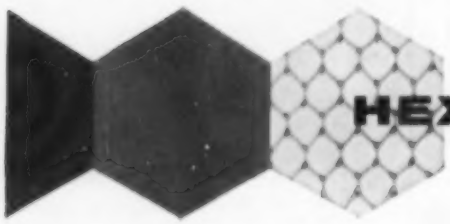
Region	Place	Date
Southern	Birmingham, Alabama	April 5-7
Southwestern	Fort Worth, Texas Hilton Hotel	April 8-10
South Pacific Const	San Francisco, California	April 12-13
Pacific Northwest	Spokane, Washington Davenport Hotel	April 19-21
Inter-Mountain	Salt Lake City, Utah Utah Hotel	April 26-28
Great Lakes	Toledo, Ohio	May 7-8
Midwestern	Indianapolis, Indiana Severin Hotel	May 10-11
Canadian	Quebec, Quebec Chateau Frontenac	May 17-18
East Central	Washington, D. C. Shoreham Hotel	May 24-25



HONEYLITE (shown above actual size) installation is simple, inexpensive. For full ceilings, aluminum T-bars are used to suspend **HONEYLITE** panels below lighting units. **HONEYLITE** is also ideal for use in troffer diffusers and recessed lighting fixtures.

Gimbels builds for the future with HONEYLITE ✻®

For beauty, for life-long economy of operation, and for **sales**—Gimbels has installed **HONEYLITE** luminous ceilings throughout its new Cheltenham, Philadelphia store. In the luxuriant, shadow-free light of a **HONEYLITE** ceiling, merchandise moves **faster** because it looks **better.**
But there's more to **HONEYLITE** than meets the eye! Its thousands of hexagonal, aluminum honeycomb cells break up sound so effectively that a **HONEYLITE** ceiling has a **noise reduction coefficient of .46!** This means a luminous ceiling of uninterrupted beauty—a ceiling that minimizes the need for separate acoustical installations that add to cost and detract from appearance. Before you build or redecorate, find out more about **HONEYLITE,** the UL approved, all-metal ceiling that transmits light with 95%-plus efficiency. . . permits free circulation of air around lighting units . . . leaves sprinkler heads unblocked for immediate operation in case of fire. Additional information upon request.



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PUBLICATIONS

The Publications of the Illuminating Engineering Society listed here summarize in printed form the vast amount of research, investigation and discussion of hundreds of qualified members of the Society working on technical committees. They contain the latest available information about many aspects of the art and science of illumination, including details of application as well as the lighting techniques involved. Each publication listed here is supported by the full authority and approval of the Illuminating Engineering Society.

I.E.S. Publications are available, in single copies or in bulk, to anyone requiring knowledge of the newest in lighting application and the supporting technical information. Published prices cover only the cost of production and handling. Quantity prices vary and are lower than the single-copy prices shown in this listing. Should quantities be desired for distribution, such as for educational or promotional purposes, prices may be obtained by writing Publications Office.

Each publication is numbered for easy ordering by using the coupon on this page. Correspondence concerning publications should be addressed to: Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

(Supersedes all lists prior to November 1955)

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(1) I.E.S. LIGHTING HANDBOOK, Second Edition

LATEST! One volume, 987 pages. Published 1952. Complete revision of first edition includes basic information on all phases of lighting practice and technique, based upon recently developed standards. Contains 18 technical reference and application sections; complete appendices of information regularly used; 655 photos, drawings, lighting tables, charts; fully cross-indexed . . . over 4500 items. For use of lighting engineers and specialists, consultants, architects, designers . . . all who plan, install and manufacture lighting systems and equipment.

$8.00 per copy; $6.40 in lots of ten or more. Add 50c for shipment abroad. *I.E.S. Members are entitled to one copy of the Handbook at $5.50 unless previously ordered.*

I.E.S. RECOMMENDED LIGHTING PRACTICES

These booklets are the complete, standard recommendations for lighting the prescribed areas, and are among the most comprehensive and important of all Society publications. As indicated, some of these recommendations are the work of committees of the American Standards Association, with collaboration by appropriate committees of the I.E.S. All have the approval of the Council of the Illuminating Engineering Society, and are the latest official I.E.S. recommendations.

In general, the information contained in these Recommended Lighting Practices covers completely the area shown in the title. Included in the data are suggested types of lighting systems and luminaires; levels for general lighting and for specific areas; analyses of seeing tasks; and other information essential to lighting the area and of value to lighting engineers and specialists, architects, construction people and others. Each practice is fully illustrated with charts and photographs.

(2) OFFICE LIGHTING
I.E.S. Recommended Practice (1947) 50c

(3) STORES & OTHER MERCHANDISING AREAS
I.E.S. Recommended Practice (1948) 50c

(4) SCHOOL LIGHTING
American Standard Practice (1948) 50c

(5) LIBRARY LIGHTING
I.E.S. Recommended Practice (1950) 50c

(6) DAYLIGHTING
I.E.S. Recommended Practice (1950) 50c

(7) SPORTS LIGHTING
I.E.S. Recommended Practice (1950) 50c

(8) INDUSTRIAL LIGHTING
American Standard Practice (1952) 50c

(9) STREET AND HIGHWAY LIGHTING
American Standard Practice (1953) 50c

(10) SUPPLEMENTARY LIGHTING
I.E.S. Recommended Practice (1953) 50c

(11) RESIDENCE LIGHTING
I.E.S. Recommended Practice (1953) $1.00

Quantity prices upon request.

COMMITTEE REPORTS ON LIGHTING IN INDUSTRY

Lighting recommendations based on recent studies (research, surveys of current practice, and experimental installations) of the appropriate subcommittees of the I.E.S. Committee on Industrial Lighting. Completely illustrated, these reports contain detailed information on many lighting problems peculiar to the industry or operation involved as well as providing general data as to lighting systems and luminaires; recommended quantity and quality of illumination; and analyses of specific seeing tasks.

(12) LIGHTING FOR WOOLEN AND WORSTED TEXTILE MILLS (1949) 50c

(13) LIGHTING FOR MACHINING OF SMALL METAL PARTS (1949) 50c

(14) LIGHTING FOR FLOUR MILLS (1949) 50c

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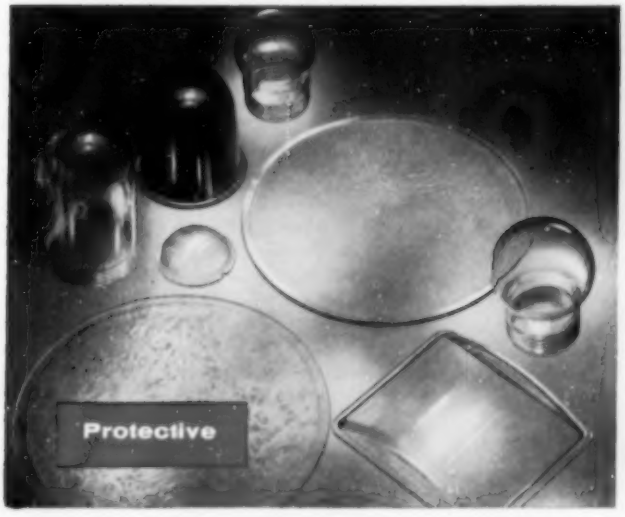

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• DEPENDABILITY

GERING Products • Inc.
KENILWORTH, N. J.

BRANCH Offices: Chicago, Ill. Mansfield, Ohio. Cleveland, Ohio. Detroit, Mich.

(Continued from page 40A)

who is Director and Vice-President in charge of sales; **C. A. Wilde,** Vice-President in charge of engineering and manufacturing; and **K. A. M. Hayes,** Secretary-Treasurer.

The appointment of **J. C. Hamilton** as manager of Sales has been announced by Advance Transformer Co., Chicago, Ill. Mr. Hamilton was formerly associated with the company as Sales Engineer.

Harold J. Ronan has been appointed District Sales Supervisor of the Detroit district for the Lighting Division of Sylvania Electric Products Inc., with his office at 7800 Intervale Ave. in that city. Mr. Ronan was formerly a vice-president of the Illuminating Engineering Co., City Sales Manager with Sun-Lite Manufacturing Co., and lighting field representative with Sylvania.

Duncan T. O'Brien has joined the New York office of Day-Brite Lighting Inc. as lighting salesman, covering the Brooklyn, Queens and Long Island areas. Mr. O'Brien was most recently employed as salesman with the General Electric Supply Co.

The Wire and Cable Section of the National Electrical Manufacturers Association elected officers at its September 26-28 annual meeting. Re-elected are **A. D. R. Fraser,** president of the Rome Cable Corp., as chairman; **H. B. Bassett,** president of Acme Wire Co., as vice-chairman. **B. F. Ibsley,** Wire and Cable Dept., General Electric Co., has been elected as a second vice-chairman.

Raoul Du Chatellier has been appointed Export Manager for Sola Electric Co., Chicago, and will direct distribution and sales of the company's products outside continental United States. He was previously a sales engineer and assistant export manager for the firm.

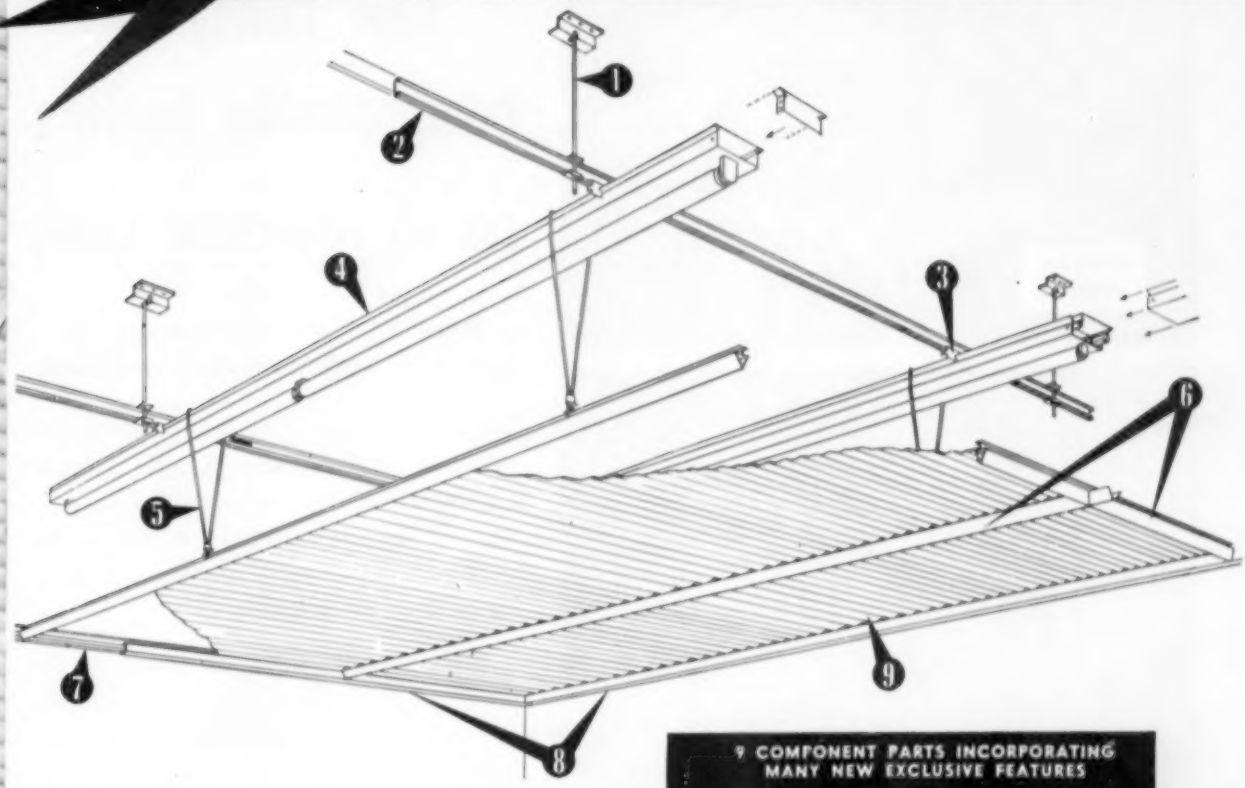
Two gold medals, the nation's highest awards in voluntary standards, were presented by the American Standards Association, October 25. **Harold S. Osborne,** retired chief engineer of the American Telephone and Telegraph Co., and past president of the International Electrotechnical Commission, was presented with the Howard Coonley Medal for "service in advancing the national economy through voluntary standards." The Standards Medal, awarded annually for leadership in the development and application of voluntary standards, was presented to **James G. Morrow,** Steel Co. of Canada, Ltd., Hamilton, Ont. The awards were made during ASA's Sixth National Conference on Standards, sponsored jointly with the National Bureau of Standards, in Washington, D. C.

(Continued on page 45A)

PRESENTING

smithcraft overall illumination

"TODAY'S GREATEST VALUE IN WALL-TO-WALL LIGHTING"



Smithcraft Overall Illumination introduces a truly "custom-made" appearance to wall-to-wall lighting. Each of the corrugated plastic modules is contained in a mitred craftsmanlike framing providing an interesting accent pattern and relief from the monotony of an unbroken expanse of shielding. Framing runners are V-shaped to reflect light and eliminate annoying black bands. The entire system glows with softly-diffused light . . . uniform, comfortable and free from shadows.

Smithcraft Overall Illumination is simple and easy to install incorporating an exclusive new levelling feature which saves hours and dollars in installation. The system is installed in new construction or in remodelling projects regardless of the irregularities of the ceiling construction or of the room and regardless of the location of pipes, ducts, beams or other obstructions.

Smithcraft Overall Illumination (we call it S.O.I.) offers so many new appearance, lighting, installation and maintenance factors you really owe it to yourself to find out more about it.

Send now for the brand new folder illustrating and describing S.O.I.

9 COMPONENT PARTS INCORPORATING MANY NEW EXCLUSIVE FEATURES

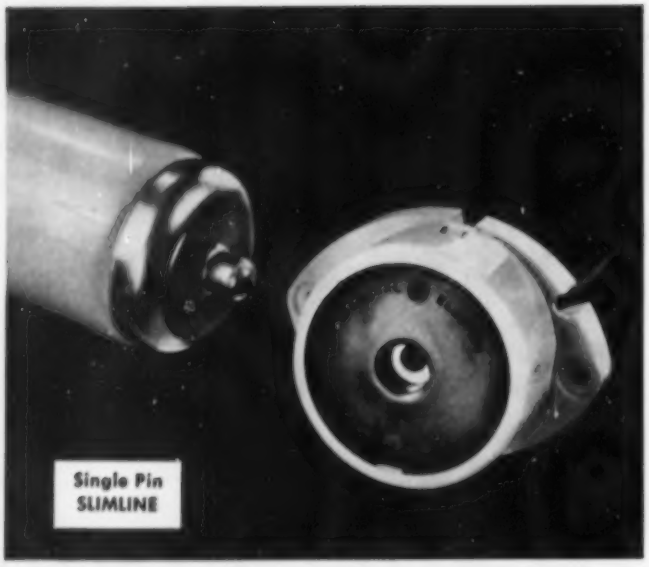
1. **Hanger Assembly** — Only part attached to ceiling . . . incorporates levelling means.
2. **Supporting channel** — Levelled by hand turning of bolts — no further levelling of system.
3. **Lighting Strip Hanger** — Slides over strip; locks to supporting channel. Location of strip may be adjusted in both directions.
4. **Lighting Strip** — Top quality Rapid-Start units with ETL — certified, Series — Sequence Ballasts. End caps become couplings in continuous rows.
5. **Runner Hangers** — Fit anywhere on strip; attach by slide fittings. Provide exact spacing — eliminate levelling difficulties.
6. **Framing Runners** — Pre-cut and mitered — lock firmly in place. V-shaped to pick up light and eliminate dark bands.
7. **Wall-channel** — Pre-cut to convenient lengths; no need for careful end-to-end fitting or close corner fitting.
8. **Snap-on molding** — Snap on to wall channel. Provide exact spacing for framing runners at wall.
9. **Corrugated Vinyl Sheets** — Lock in framing runners. Complies with National Building Code that these sheets shall not be over 10' in length.

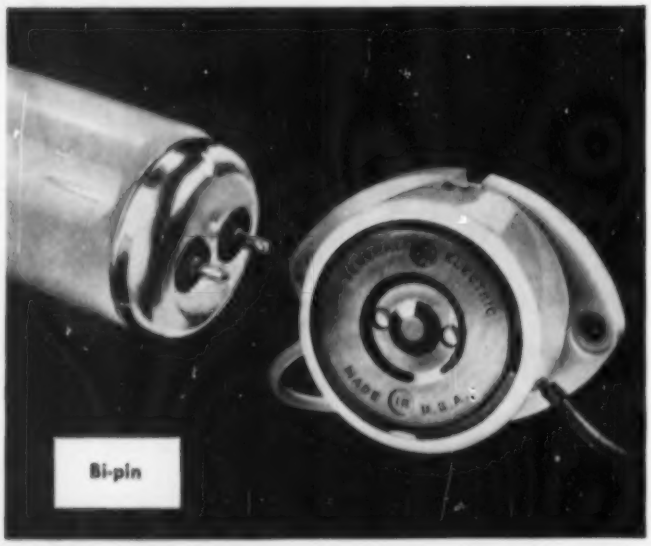
Smithcraft

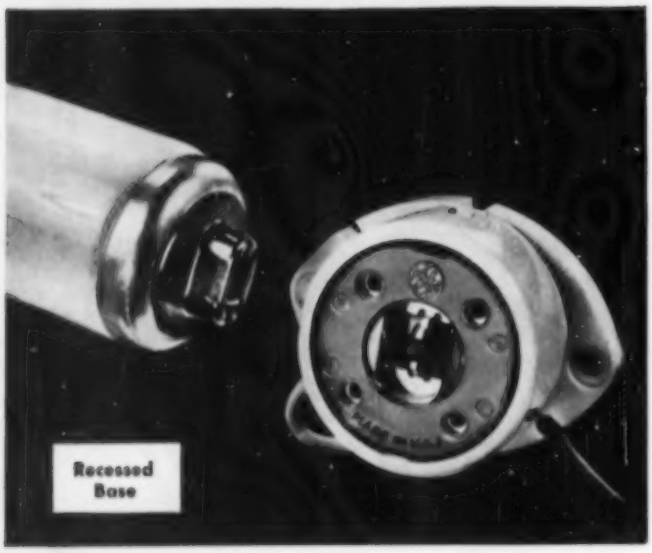
LIGHTING DIVISION

CHELSEA 50, MASSACHUSETTS

America's finest fluorescent lighting systems







G-E announces new family of compressible holders

FOR ALL FLUORESCENT LAMPS

Dark area sharply reduced by minimum back-to-back dimensions

These new G-E ear mount holders completely eliminate danger of falling lamps . . . single pin Slimline, bi-pin, or recessed base . . . they all stay put without safety guards. No twisting or positioning needed. You snap lamps in or out instantly.

Every member of this new family of G-E lampholders is ear-mounted . . . compressible . . . and has identical physical and minimum back-to-back dimensions providing interchangeability. The exceptionally shallow design cuts down dark area substantially. Either vertical or horizontal lamp contact position may be had for bi-pin or recessed end lamps without change in mounting location. This family of lampholders has been approved for use in outdoor signs. For complete information on these new lampholders, write Accessory Equipment Department, General Electric Company, Bridgeport 2, Connecticut.

Progress Is Our Most Important Product

GENERAL ELECTRIC

(Continued from page 42A)

Deaths

Sections and Chapters of IES report with sorrow the deaths of the following members:

Alex Davidson — Hamilton, Ontario, Chapter.

Steve Hines — Montreal Section.

R. O. Warffuel — Pittsburgh Section.

NEW MEMBERS

At the meeting of the I.E.S. Council held at New York, N. Y. on October 13, 1955, the following were elected to membership. Names marked * are transfers from Associate Member grade.

ALABAMA CHAPTER

Associate Member:

Caldwell, J. H., Jr., Alabama Power Co., Jasper, Ala.

ARIZONA SECTION

Associate Members:

Abell, G. W., Arizona Public Service Co., Yuma, Ariz.
Herren, C. R., Arizona Public Service Co., Phoenix, Ariz.
Lambe, S. S., Salt River Power District, Phoenix, Ariz.
Mein, A. A., A. B. C. Electrical Supply Co., Coolidge, Ariz.
Mitchell, M. L., E. C. Junken Electric Co., Yuma, Ariz.

BRITISH COLUMBIA SECTION

Associate Member:

Thomas, J. R., 3907 Knight Road, Vancouver, B. C.

CAPITAL SECTION

Member:

Ginther, R. J., Naval Research Laboratories, Washington, D. C.

Associate Members:

Correa, L. L., 1824 Taylor N. W., Washington, D. C.
Helwege, Miss Claire E., Potomac Electric Power Co., Washington, D. C.

CENTRAL ILLINOIS CHAPTER

Associate Members:

Heimberger, P. W., Colind Photography, Peoria, Ill.
Oberlander, O. W., Oberlander Electric, Peoria, Ill.
Schneider, D. N., Central Illinois Light Co. Peoria, Ill.

CHICAGO SECTION

Members:

Bunner, R. W., General Electric Co., Danville, Ill.
Vavrinek, L. J., Benjamin Electric Mfg. Co., Des Plaines, Ill.

Associate Members:

Belsan, Roger, Benjamin Electric Mfg. Co., Des Plaines, Ill.
Davis, D. W., Lighting Products Inc., Highland Park, Ill.
Kempf, V. T., 7912 W. 46th St., Lyons, Ill.
Regas, G. P., Kralovec & Best, Chicago, Ill.

CLEVELAND SECTION

Member:

Ickis, L. S., General Electric Co., Cleveland, Ohio.

Associate Members:

Artopoeus, J. E., J. E. Artopoeus & Associates, Bay Village, Ohio.
Bryant, C. E., III, Westinghouse Electric Corp., Cleveland, Ohio.
Hanratty, Mrs. Lucille, General Electric Co., Cleveland, Ohio.
Liljegren, R. B., The Wakefield Co., Vermilion, Ohio.
Lundgren, R. A., General Electric Co., Cleveland, Ohio.
Masters, R. H., The Ohio Power Co., Canton, Ohio.
McMillan, W. R., Jr., Westinghouse Electric Corp., Cleveland, Ohio.
Resler, L. B., Ohio Power Co., Newark, Ohio.
Schaller, B. E., General Electric Co., Cleveland, Ohio.
Siegrist, G. S., The Jones Metal Products Co., West Lafayette, Ohio.
Smith, P. R., Mitchell Mfg. Co., Cleveland, Ohio.
Thurston, T. T., Westinghouse Electric Corp., Cleveland, Ohio.
Vild, D. J., American Society of Heating & Air Conditioning Engineers, Cleveland, Ohio.
Wigert, J. W., Westinghouse Electric Corp., Cleveland, Ohio.

CONNECTICUT SECTION

Member:

Guy, J. D. C., Jr., General Electric Co., Hartford, Conn.

Associate Member:

Duquette, R. J., General Electric Co., New Haven, Conn.

CORNHUSKER CHAPTER

Associate Members:

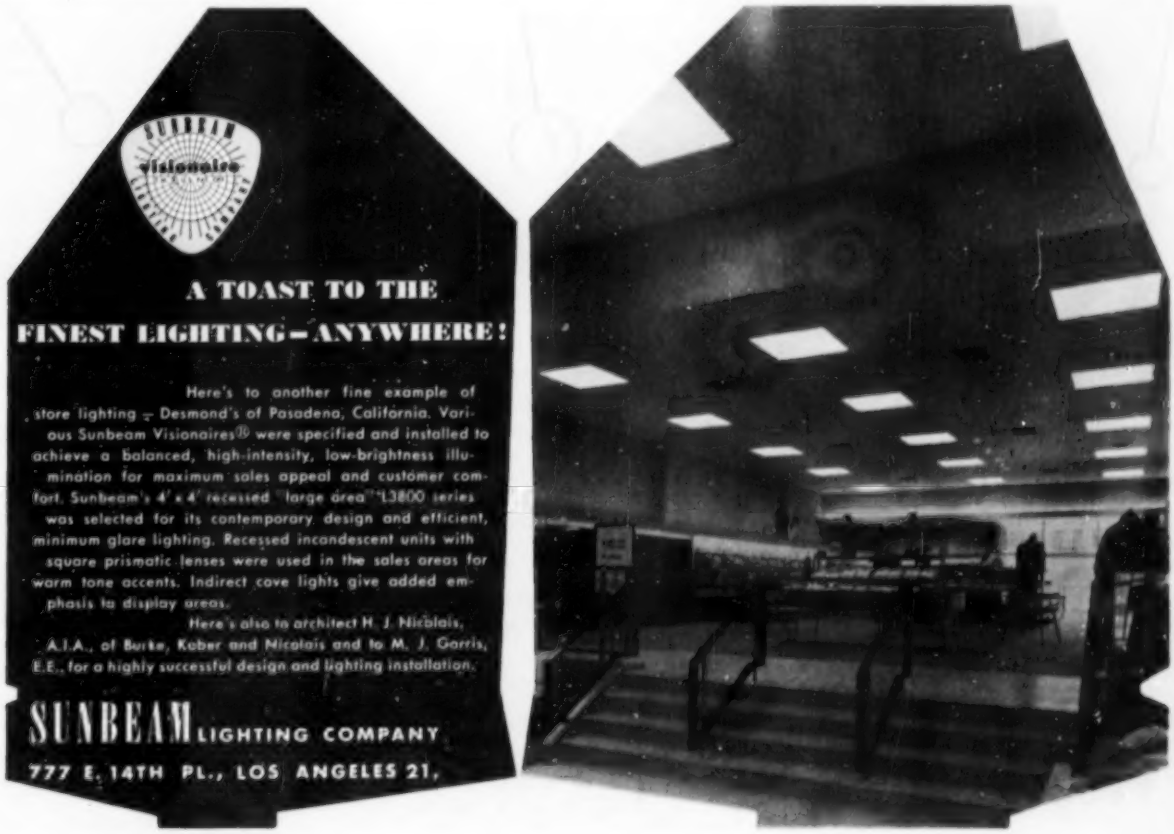
Hughes, D. L., 1811½ Broadway, Scottsbluff, Neb.
Meharon, G. C., U. S. Corps of Engineers, Omaha, Neb.

EASTERN PENNSYLVANIA SECTION

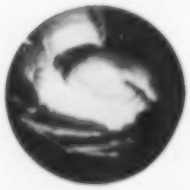
Member:

*Orkvitz, C. A., Westinghouse Electric Corp., Allentown, Pa.

(Continued on page 46A)


SUNBEAM
visionaire
A TOAST TO THE
FINEST LIGHTING—ANYWHERE!
Here's to another fine example of store lighting — Desmond's of Pasadena, California. Various Sunbeam Visionaires® were specified and installed to achieve a balanced, high-intensity, low-brightness illumination for maximum sales appeal and customer comfort. Sunbeam's 4' x 4' recessed "large area" L3800 series was selected for its contemporary design and efficient, minimum glare lighting. Recessed incandescent units with square prismatic lenses were used in the sales areas for warm tone accents. Indirect cove lights give added emphasis to display areas.
Here's also to architect H. J. Nicolais, A.I.A., of Burke, Kober and Nicolais and to M. J. Garris, E.E., for a highly successful design and lighting installation.
SUNBEAM LIGHTING COMPANY
777 E. 14TH PL., LOS ANGELES 21,

Ask these questions, too, when you judge a fluorescent lamp . . .



Is it made with Halo Phosphor?

No other phosphors in use today can match Halo Phosphors for maintaining high light output and original color. Westinghouse (and only Westinghouse) uses Halo Phosphors throughout its entire fluorescent lamp line.

Is it the correct type, size and color for the lighting job to be done?

In the Westinghouse fluorescent family of 290 different lamps—including Slimline and Rapid Start—there's a type and size precisely right for every office, plant and merchandising application. Colors include seven different shades of "white" alone.

How about quality control?

From raw materials to finished product, every Westinghouse fluorescent lamp is subjected to *480 inspections and tests* before approval for shipment.

For the full story on how to get more for your money in fluorescent light, contact your Westinghouse Lamp Representative.

YOU CAN BE SURE...IF IT'S

Westinghouse

(Continued from page 45A)

Associate Members:
Benatan, Jack, Duro Test Corp., Harrisburg, Pa.
Gallatin, N. R., 1548 Wayne Ave., York, Pa.
Koch, H. B., Jr., Gilbert Assoc. Inc., Reading, Pa.

FLORIDA SECTION

Associate Member:
Barber, H. F., Graybar Electric Co., St. Petersburg, Fla.

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Barnard, J. W., Electricity Supply Commission, Johannesburg, South Africa.
Kwong, Norman, Benjamin Electric Co. Ltd., Tottenham, London N., England.
Longlands, J. S., General Electric Co. Ltd., Glasgow C. 2, Scotland.
Payn, C. R., Hubert Davies & Co. Ltd., Johannesburg, South Africa.
Shapiro, H., Federal Electrical (Pty) Ltd., Johannesburg, South Africa.

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Associate Members:
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VanLeigh, Logan, Appleton Electric Co., Atlanta, Ga.

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Mendelsohn, Herbert, Sun Ray Lighting Corp., Kansas City, Mo.
Meunier, R. J., Mitchell Mfg. Co., Kansas City, Mo.

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Kimmel, J. S., Jr., Republic Electric Co., Davenport, Iowa.
MacMartin, W. O., Kayline Co., Tama, Iowa.
Martin, H. D., Sylvania Electric Products Inc., Davenport, Iowa.
Miller, G. F., Republic Electric Co., Davenport, Iowa.
Palmer, G. F., Tri-City Electric Co., Davenport, Iowa.

MARITIME CHAPTER

Associate Member:
Abbass, F. J., N. B. Electric Power Commission, Fredericton, N. B.

MEXICO CHAPTER

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MIAMI VALLEY CHAPTER

Associate Member:
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Associate Members:
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Long, E. A., Long Sign Co., Detroit, Mich.
Ross, D. M., Sylvania Electric Products, Inc., Detroit, Mich.

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Clark, J. A., Southern College of Optometry, Memphis, Tenn.
Cox, H. S., Southern College of Optometry, Memphis, Tenn.
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Echols, Don, Southern College of Optometry, Memphis, Tenn.
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Hancox, W. A., Jr., Southern College of Optometry, Memphis, Tenn.
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Williamson, W. A., Southern College of Optometry, Memphis, Tenn.

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Descary, J. M., Canadian Pacific Railway, Montreal, Que.
Gottlieb, H., Modulite Inc., Montreal, Que.
Pare, Rene, Board of Electrical Examiners, Montreal, Que.

MOTHER LODE CHAPTER

Members:
Early, Doyt, State Dept. of Education, Sacramento, Calif.

(Continued on page 49A)

how to judge a fluorescent lamp . . . point no. 2

ask about **HIGHEST LIGHT OUTPUT**

Fluorescent lamps deficient in light output are apt to be costly at any price. Reason: in order to attain a given light level with such lamps, you need not only more of the lamps themselves, but also—to hold and operate the extra lamps—*more fixtures and more power*. Thanks to a steady stream of new ideas in its fluorescent lamp design, materials and manufacture—ideas carefully evaluated through photometric testing as shown above—Westinghouse now offers you fluorescent lamps conservatively rated for light output at up to *63 lumens per watt*.

YOU CAN BE SURE...IF IT'S Westinghouse

Day-Brite CFI (Comfort For Industry) lighting provides comfortable lighting levels on all work surfaces by taking full advantage of wall and ceiling reflectances. Electric Controller & Manufacturing Co., Cleveland, Ohio.

Better seeing, better production with new Day-Brite **CFI** *lighting*

When you put "comfort" lighting to work for you, benefits are immediate and continuous—particularly if you install new Day-Brite CFI (*Comfort For Industry*) lighting.

By washing out brightness contrasts *at the ceiling*—as illustrated in the Day-Brite CFI-10 installation above—worker eye comfort is greatly improved. Nervous and muscular tensions and fatigue are reduced; morale and efficiency are boosted. Speedier and more accurate control of many work operations results; over-all higher standards of production are achieved.

There are two Day-Brite CFI units available —the CFI-10 and CFI-25. They provide 10% and 25% upward lighting, respectively. Updraft ventilation promotes cool operation and minimizes dust deposits on fixture bodies.

SEE, EXAMINE and COMPARE Day-Brite with any other lighting. Look at the fixtures—not just the pictures!

CALL YOUR DAY-BRITE REPRESENTATIVE! You'll find his industry-lighting experience valuable.

5496

Day-Brite Lighting, Inc.

5432 Bulwer Ave.

St. Louis 7, Missouri

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

(Continued from page 48A)

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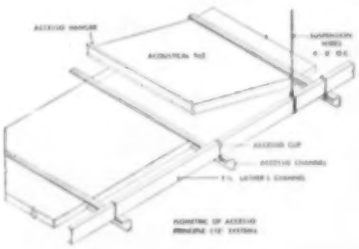

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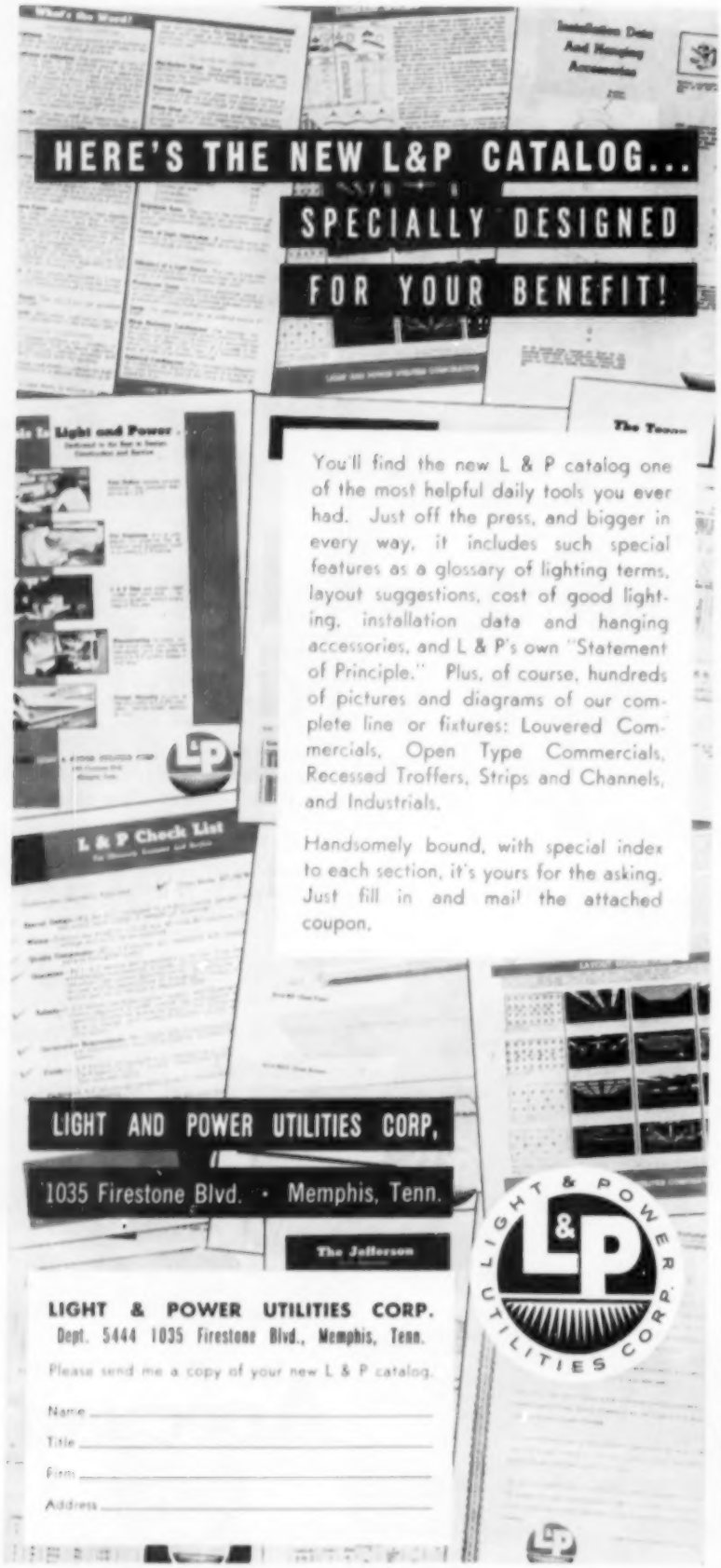
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(Continued on page 52A)

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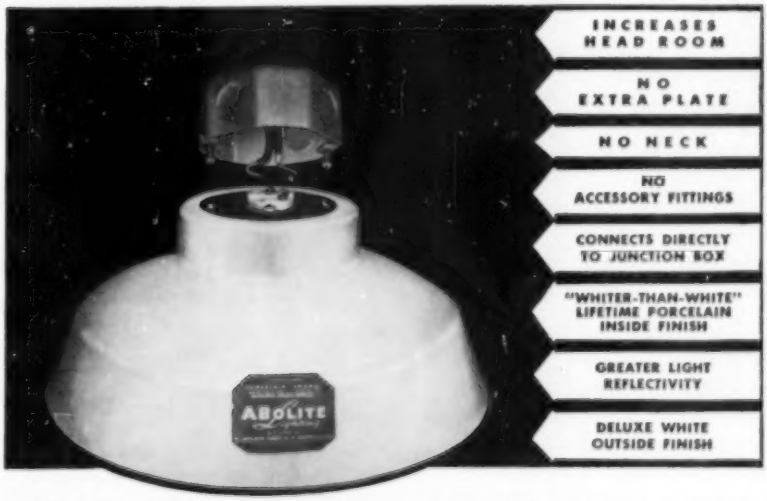

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INDEX TO ADVERTISERS
November 1955

Abolite Lighting Division Jones Metal Products Co.	53A
Accesso Systems Inc.	49A
Baker-Barkon Co.	55A
Benjamin Electric Mfg. Co.	Inside Front Cover
Certified Ballast Manufacturers	Inside Back Cover
Curtis Lighting Inc.	11A
Day-Brite Lighting Inc.	48A
Eastern Fixture Co.	29A
Fluorescent Fixtures of California	33A
Garden City Plating & Mfg. Co.	23A
General Electric Co., Accessory Equipment	44A
General Electric Co., Apparatus	34A
General Electric Co., Lamp	18A
Gering Products Inc.	42A
Gibson Manufacturing Co.	15A
Edwin F. Guth Co.	Back Cover
Hexcel Products Inc.	36A
Kliegl Bros.	54A
Kopp Glass Inc.	39A
Light & Power Utilities Corp.	50A
Litecontrol Corp.	4A
McPhilben Manufacturing Co.	53A
Meierjohan-Wengler	55A
Micro Balancing Inc.	52A
Pfaff & Kendall	51A
Prescolite Mfg. Co.	24A
Pryne & Co. Inc.	21A
Rambusch Decorating Co.	17A
Sheffield Plastics Inc.	55A
Smithcraft Lighting Division	43A
Sola Electric Co.	56A
Starring & Company Inc.	2A
Sunbeam Lighting Co.	45A
Sylvania Electric Products Inc.	30A, 41A
Wakefield Company	26A
Westinghouse Electric Corp., Lamps	12A, 46A-47A
Westinghouse Electric Corp., Lighting	1A
Weston Electrical Instrument Corp.	40A

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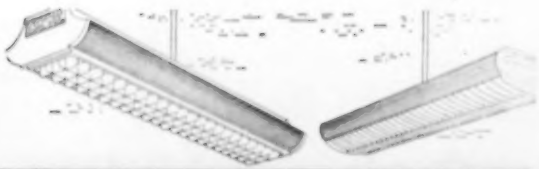

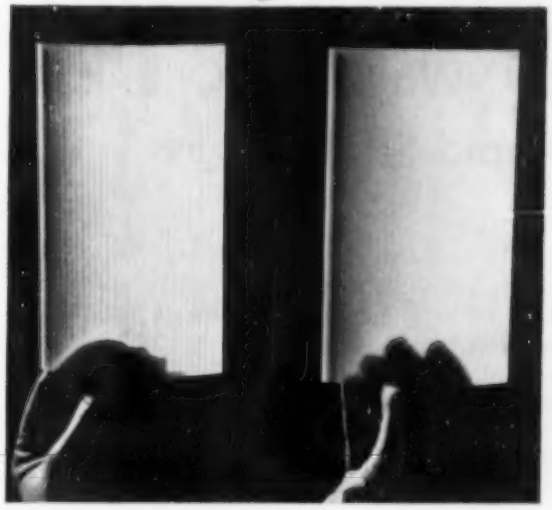

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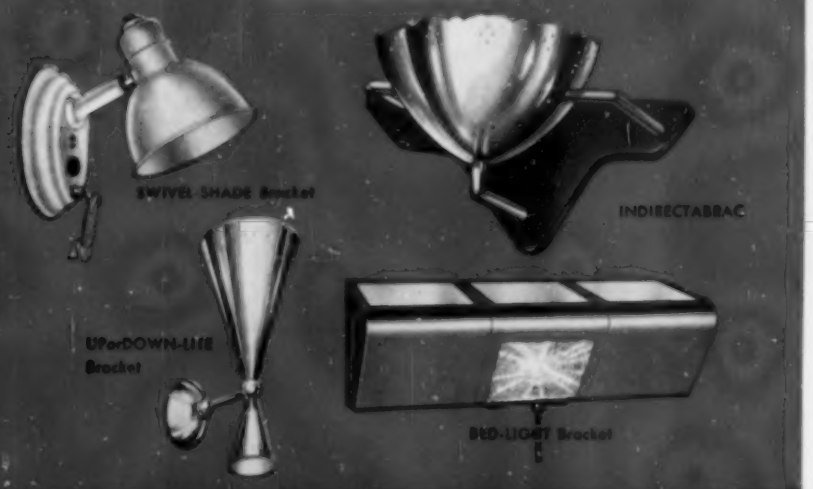
BRIGHTEN DARK CORNERS AND NEAR-WALL AREAS WITH

INCANDESCENT



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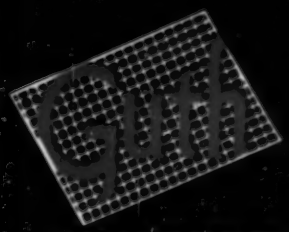
APPLICATIONS GALORE!

. . . in barber shops; fitting rooms; over hospital beds, chalk boards, mirrors; for desks near walls; along ceiling beams . . . and many other spots that are difficult to light efficiently with conventional fixtures.

FLUORESCENT



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